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SELECTIVE RADIATION.

The study of selective radiation has become of much interest because of the improved forms of electric lamp which have been put out during the last few years, and whose efficiency is said to depend, in part at least, upon this not well understood phenomenon. Recent discussions of this subject have distinguished between two kinds of selectivity—that due to gaseous radiation, and that of solid radiators. The latter type is probably the more interesting. By selective radiation is meant now any radiation differing from that of the theoretical black body. This has been determined by studying the radiation from an enclosed space. Any departure from the character of radiation thus found is said to be selective. It happens that all known bodies depart more or less from this law. It happens also that the law of black-body radiation represents the greatest amount of energy which can be radiated from a body at a given temperature; therefore, any other body at the same temperature radiates less energy. Moreover, the radiation from the black body is greatest in the long-wave part of the spectrum, and therefore non-black-body radiation is more efficient as a source of light.

It is rather singular that the substance first used in making a successful incandescent lamp was carbon, and carbon as a radiator approaches nearer to the black body than any other material which could be used. For this reason the carbon lamp possesses a radiator of the most inefficient type. It was, of course, its wonderful mechanical properties which enabled it to be used at all, and in this respect it is far superior to any substance we yet have.

It is interesting to remember that the other material suggested and tried before carbon—that is to say, platinum—departs the most widely from the black-body law, and it is therefore the most efficient radiator of light; but, while platinum possesses certain valuable properties to a remarkable degree, its use for incandescent lamp filaments was not a success.

The inefficiency of the carbon filament as a source of light left a large field for improvement, but it has been only recently that we have been able to overcome the mechanical difficulties and to substitute for carbon other substances, and in this way improve the efficiency. Tantalum, tungsten and other materials are now used, and they are, of course, more efficient radiators than the carbon. The problem to be solved is not to obtain a more efficient radiator, because that would solve itself—carbon being the worst; but to find a substance that will give more efficient results. The efficiency of a radiator depends not only on its substance, but upon the temperature at which it radiates;

and a high-efficiency radiator may give less efficient results than a poorer one, if the latter may be run at a higher temperature. This point was brought out at the recent special meeting of the Illuminating Engineering Society, at which Dr. Lummer delivered an address. He said that it was probable that the better efficiency of the newer filaments as compared with carbon was due to the higher temperature at which they were run. This same view is taken by Messrs. C. W. Waidner and G. K. Burgess, in a preliminary discussion of selective radiation of incandescent lamps, appearing in the *Bulletin of the Bureau of Standards*. They compared carbon, tungsten and tantalum lamps, measuring for each the intensity of radiation in different parts of the spectrum. These measurements show, as was to be expected, a lower efficiency of the carbon filament, but the difference is hardly great enough to account for the increase in efficiency obtained. They show, however, that the tantalum and tungsten filaments are at a higher temperature than carbon, and since the amount of light radiated from a body depends upon the twelfth power of the temperature, the gain in efficiency seems, without doubt, to be due to the temperature effect. An interesting fact should be borne in mind here: at the same true temperature a carbon filament would emit more light than a metal filament, but it would also emit still more heat, because it is less efficient.

Another interesting fact brought out in the discussion is that tantalum is more selective in its radiation than tungsten, and would probably be more efficient than the latter at the same temperature. The tungsten lamp is an improvement over the tantalum lamp in the same way that the latter is over the carbon lamp, because it operates at a higher temperature. Platinum, which is the most efficient of all radiators, unfortunately can not even compete with carbon, the poorest.

DIFFUSED AND DIRECTED LIGHT.

Rapid advance is being made in methods of illumination, particularly with respect to the lighting of rooms. The usual practice used to be to place a sufficient number of lamps of the desired kind in the room to be lighted. When the lamps were brilliant it was found necessary to put shades around them in order to diffuse the light and prevent the objectionable blinding glare which would otherwise exist. For general purposes such shaded lamps were fairly satisfactory, but in other cases it was found necessary to eliminate the shadows which are thrown when light comes from a limited number of sources. The next step was to use a large number of small units, each unit being shaded when necessary.

To secure still more perfect diffusion, the so-called concealed system of lighting was introduced, the lamps being placed out of sight, but so that they may throw light on a lightly tinted surface, from which it is diffused into the room. This seemed at first almost ideal. The light is soft, and there is no blinding glare; but it did not take long for it to be discovered that this system was lacking in some way, and it was found to be due to the entire absence of shadows. When the light comes from a large surface, such as an illuminated ceiling, the intensity of illumination is practically the same in all directions, and therefore no shadows are cast. This condition of affairs is unnatural, and while we might, perhaps, gradually accustom ourselves to it, at the present time it is not entirely satisfactory.

On the other hand, directed lighting—that is to say, lighting accomplished by means of a definite number of lamps—is objectionable, if the lamps themselves be not well shaded, for the eye objects to the image of a brilliant source of light upon its retina. The most satisfactory results would seem to be given by a combination of the two systems, the illumination being provided by means of diffused light, while the shadows necessary for comfort are secured by the addition of a few exposed lamps.

The reason for the unsatisfactory effect of a shadowless illumination seems to be in the inability of the eye to judge shapes and distances when everything is equally illuminated; in other words, there is no perspective.

This question of diffused and directed lighting has been brought up a number of times before the Illuminating Engineering Society, and in particular it was discussed by Mr. E. A. Norman in a paper read before the New York section at the March meeting. An abstract of this paper will be given in a later issue of this journal. The measurements that have been made could not, of course, prove that one system is more satisfactory in every way than the other. The feeling of the observers must be depended upon for this. But they did show that the diffused system, as there used, was inefficient as compared with the directed system using exposed lamps. Naturally, when light must be reflected from a surface before it falls upon the object to be lighted, some loss will occur, but the amount of loss will depend largely upon the character of the reflecting or diffusing surface; and it seems likely that in the recent discussions of this subject, in which the comparisons have been very unfavorable to diffused lighting, the system has been lacking in these respects, and that much better results might have been secured. Moreover, the arrangement of the lamps, and the shape of the diffusing surface will, no doubt, have considerable to do with this matter. It is not safe, therefore, to say that, in general, the diffused system has an efficiency of only one-third that of the directed system.

When studying diffused systems of lighting, the effect of frosting the globes of incandescent lamps should be borne in mind. This was discussed in the ELECTRICAL REVIEW for April 6 by Dr. E. P. Hyde, who showed that the unusual amount of absorption found to take place was probably due to a deposit of carbon on the inner surface of the globe. Reference was made to this matter editorially, and it was said that probably the same effect would be found when using ground-glass shades, though to a much less degree; but dust on the inner surface of a frosted globe should be particularly objectionable, as here it resembles the deposit on the inner surface of the bulb. At a recent meeting of the Illuminating Engineering Society curves taken by Mr. P. S. Millar, to determine to what degree the first

effect exists were shown. His results showed that in this particular case it was slight, perhaps not more than one per cent. It will, of course, vary considerably with the shape and size of the globe. This may be compared with the fourteen per cent loss observed by Mr. Hyde when the bulbs themselves were frosted. During this meeting, however, Mr. V. R. Lansingh laid stress upon the importance of preventing dust from entering globes and shades, as it had been found in practice to cut down the amount of light, at times, by twenty-five per cent or more. This bears out the second inference made above, and is a point of much practical importance. No shade or globe closed at the bottom should be left open at the top to collect dust.

LOCOMOTIVE SIGNALING.

A phase of railway signaling which is receiving more attention to-day than heretofore is that of giving the signals upon the train itself. The idea is an old one, and has been tried a number of times, but has not yet come into much use. It is rather interesting to note that the introduction of the electric system makes not only this method of signaling, but most of the automatic types of signals, more difficult to install than when steam locomotives are employed. This, of course, is merely due to the fact that the rails are used as one part of the power supply circuit, and therefore are not available for signaling purposes, unless specially arranged. Moreover, the use of one system of currents for the power supply will often require the signals to be made by another.

The object of making the signals on the train or the locomotive is generally merely to supplement the usual signals and to provide another safeguard. Man is so constituted that he easily acquires habits and often becomes so automatic and machine-like that he performs unconsciously acts which at first required considerable effort. This trait may act in two ways. Due to force of habit he may automatically follow the signals set without consciously reading them. On the other hand, unless he makes some conscious note of the signal, he can not remember after passing it what it was. While he might automatically stop his train at a danger signal, he might also run past a caution signal, and having made no conscious note of it, proceed as though the line were clear. For this reason a supplementary signal has great advantage, particularly if it depend upon a different human sense. If a visual signal is supplemented by an audible one, it is far less likely that the engineer will not make conscious note of either one or the other. Such a signal, therefore, particularly if carried on the locomotive, should be an additional safeguard of considerable value.

Signals on a locomotive have, moreover, another advantage: they are not affected by the weather conditions, and therefore become particularly valuable during thick weather. Again, they can be constructed so as to require some action on the part of the engineer, and in this way really appeal to a third sense also; for example, if, in addition to the usual semaphore, a bell is placed upon the locomotive which is sounded when the other signal is passed, and continues to sound until the engineer stops it, there are really three signals given—the visual one, the audible one, and the motion required to stop the latter.

It is not a difficult matter to place such signals on any locomotive, and the expense required should not be great. The main thing should be to provide a system which is entirely reliable. Many such systems have been proposed, and not infrequently it has been sought to accomplish another end—that of maintaining communication with the moving train. While desirable, this is not essential, and it complicates considerably the signal system. Its application would be of more value on a single-track road, and even then the rules governing the movement of trains should be strict, to avoid any misunderstanding or dispute arising between two approaching trains. Many systems have been suggested, and even tried, for this purpose, but for the present, at least, a hardier system—one employing rugged apparatus actuated by ample power—would seem to be the most suitable, as the engineer has no time to adjust apparatus on his locomotive. Nor should he be called upon to send or interpret complicated signals. Where communication with signal stations or other trains is desirable, a supplementary telephone line paralleling the track would, in general, afford much more satisfactory communication. However, a simple signal sounded on the locomotive as a supplement to the stationary signal beside the track would seem to have distinct advantages and not be difficult nor expensive to install. Such a signal could also be employed on electric roads without depending upon the track, and, therefore, not be influenced by the system of power supply.

ELECTRICALLY DRIVEN HYDRAULIC ELEVATORS.

It is interesting to notice how the electric motor adapts itself to various conditions, and frequently is used to supply the motive power to a device which competes directly with a similar electrical device. For example, the chief competitor of the compressed-air rock drill is the electric drill, and one of the later and interesting developments of compressed-air drills has been the addition of a small electric motor driving a little local compressor for supplying the operating power to the drill.

Another instance of this kind is the adaptation of the electric motor to driving the hydraulic elevator. The inventor of this device is thoroughly convinced that the hydraulic cylinder is better or safer for lifting elevators than the electric motor, but the latter is far more convenient, since it can draw its power from the general supply. Therefore, he attaches a motor to his hydraulic pump and transmits his power in this way through the pump and through the cylinder, instead of applying it directly by attaching the motor to his ropes.

The electric motor has a wonderful property of adapting itself to all sorts of conditions, but it sometimes happens that its adaptability is not made use of, and it is employed, as in these two cases, because it is conveniently driven by power supplied from a distant point.

The Design of a 1,500 to 3,000-Kilowatt Steam-Electric Central Light and Power Plant.[1]—I.

By Frank Koester.

NOTWITHSTANDING the fact that the majority of central stations are below 3,000 kilowatt capacity, those usually described in the technical press are of larger capacity. This may be due not only to the prominence of the plant and the exceptionally large size of prime movers, but also to the fact that they supply, either directly or indirectly, the needs of a large number of the people. The record-breaking advertising of the various manufacturers is also a potent factor in increasing the interest in these larger plants, as of course, the larger the plant the more notoriety gained by the company supplying the machinery, as well as the designer of such a plant. Such power plants are, however, as above stated, only a very small percentage of the number of plants of smaller capacity. The design of these plants in many respects is an entirely different proposition from that of the large central station, as what may be a small item in the latter may prove to be a large percentage of the total first cost of the small plant. Not only from a financial point of view is it a different proposition, but also in the technical design. Inasmuch as the breakdown of a single unit in a small plant constitutes the disability of so much larger percentage of the complete equipment, so much more important is the necessity for breakdown units, in the former. As, however, a small station can not be equipped with as large a number of emergency units as are frequently found in prominent plants, it becomes of vital importance to select the proper size of the main machinery, such as boilers, prime movers, etc. It is, therefore, the author's intention to discuss briefly the various questions encountered in the design of a small power plant. This has been done at the request of the editor of the ELECTRICAL REVIEW in order to not only describe a system which has been designed for its own peculiar conditions, but to give a system applicable to practically all general cases, for which purpose specially prepared plans have been made.

There are many items affecting the decision in regard to the requisite capacity of the plant as well as the individual prime movers, such as urban and interurban railway service, municipal and private lighting, character and amount of power load for industrial and domestic purposes, possible forms of contract, etc. There is not space here to discuss more fully this preliminary although very important special subject, as the above factors vary so widely with the character of the town; and, therefore, assuming that these points have been settled we will confine ourselves to the detail of designing.

Assuming the plant to be for supplying light and power to a given community scattered over a considerable area, the current generated in the power plant will be 2,300 volts, sixty-cycle, three-phase alternating, being stepped down at substations. On account of the character of the load curve we will assume that it has been decided to install a plant of 2,250 rated horse-power or 1,500 kilowatts. This plant shall consist of three 750-kilowatt units, one of which will be always in reserve, while the building itself will be large enough to accommodate a fourth unit of equal or greater capacity in order to meet the increasing demand after the first few years. The plant will be run condensing.

As these prime movers are so designed as to operate economically under an overload of fifty per cent, the maximum combined capacity of the two prime movers will therefore be 2,250 kilowatts. In order to choose the proper size of boilers it is necessary to know the steam consumption of the prime movers and the auxiliaries, assuming that the latter are steam-driven. Good American practice has proven that the auxiliaries consume (including leakage, drip, etc.), about ten to fifteen per cent of the total steam consumption, although there are plants where this runs up as high as twenty per cent, and some notable instances in recent prominent turbine plants where this is as low as six per cent.

Assuming further that the plant is located in a remote district where skilled labor is scarce, the water consumption will be materially increased on account of the waste incident to too frequent blowing off of boilers, draining of main steam pipes of the main prime movers and auxiliaries, etc. Under such conditions the liberal consumption of twenty pounds per kilowatt-hour (including auxiliaries, etc.), is assumed. This results in a total water consumption of $1,500 \times 20 = 30,000$ pounds per hour. Assuming that water-tube boilers have been selected and that three pounds of water will be evaporated per square foot of heating surface, boilers with 10,000 square feet of heating surface would be required. This, however, assumes normal conditions for the boilers, with an overload of fifty per cent on the turbines, and is not the condition desired, an overload of approximately thirty-five per cent being good practice for maximum economical forcing of boilers. Making allowance for this overload, approximately 11,000 square feet of heating surface is required. As it is American practice to rate boilers in horse-power and ten square feet of heating surface in a water-tube boiler is equivalent to one "boiler horse-power," 1,100 horse-power would be required, this giving a ratio of 0.73 boiler horse-power per kilowatt. This is an average figure for modern practice.

TYPE AND SIZE OF PLANT.

At least two boilers should be installed for each prime mover, which would necessitate four 275-horse-power boilers (2,750 square feet). As, however, the boilers require frequent cleaning and repairing and as there is one spare prime mover, the same spare capacity of boilers should be installed. Of course, space must also be left for two more boilers to supply the future prime mover when installed. As will be seen in the accompanying plan, Fig. 2, the boiler house runs parallel to the generating house, the boilers being arranged in one row, in batteries of two. The chimney is located between the fourth and fifth boilers, thus giving a symmetrical layout. Allowing five feet clearance between two adjacent batteries and seven feet between the batteries and the end walls, with twenty-three feet between boilers Nos. 4 and 5, which space is occupied by the chimney, boiler-feed pumps, feed-water heater, etc., and assuming that a battery of two 275-horse-power boilers has a width of twenty-four feet, the total length of the boiler house would be 143 feet. The width of the boiler house should be fifty feet, thus allowing ample clearance for withdrawing of tubes, etc.

On account of the present popularity of turbines we will adopt them for this plant. As turbines occupy a comparatively small floor space, the length given for the boiler plant is more than necessary for the turbine room, and as will be seen from the

[1] Copyright, 1907, by Frank Koester.

plan, 113 feet is all that is required. Taking into consideration the removal of the condenser tubes and the disassembling of the turbines on the generating room floor, the width of the turbine room will also be forty-eight feet. About ten feet of the generating room is set apart for switching purposes, offices, toilet and lockers, etc., thus giving a building covering 12,574 square feet, which gives 4.02 square feet per kilowatt normal rating. This figure is of course liberal, as this is a country power plant and it is not good practice to crowd the plants as is done in cities like New York, Chicago, etc., where about two to two and one-half square feet per kilowatt is the average, partly on account of the boilers being installed in two tiers and partly on account of the individual units being of enormous capacity and occupying comparatively small floor space. The height of the boiler room depends upon the height of the boilers themselves and also upon the depth of the basement, if one is adopted, while the design of coal-bunkers is also an important controlling factor.

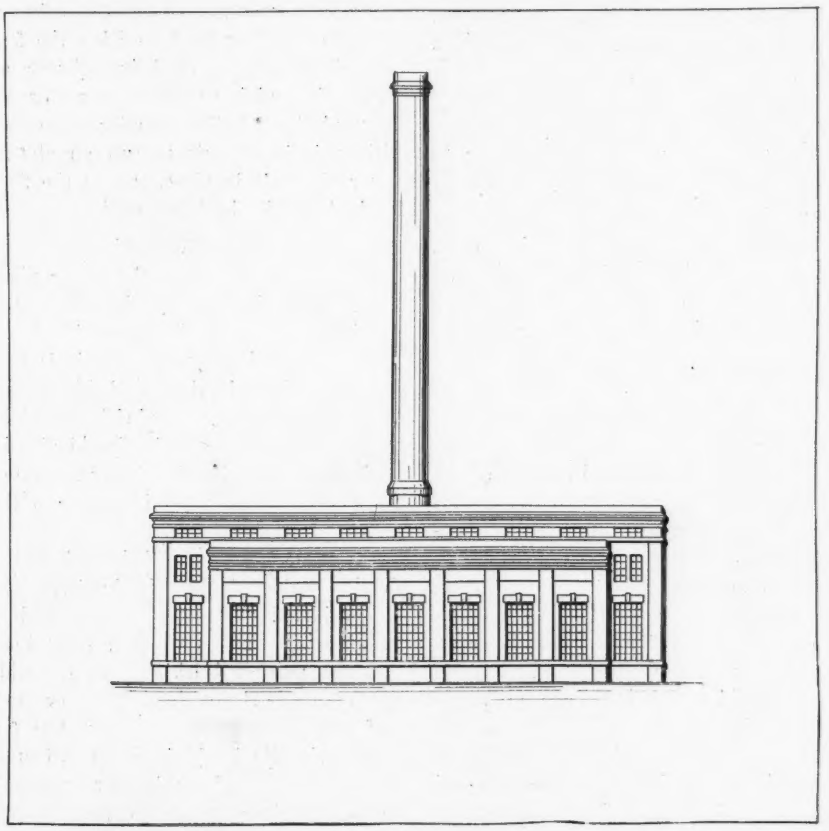


FIG. 1.—ELEVATION OF 1,500-3,000-KILOWATT STEAM-ELECTRIC PLANT.

There being many advantages in having a basement, one is therefore decided upon for this plant, the depth of which is thirteen feet from the boiler room floor to the basement floor, this giving about eleven feet clearance between the basement floor and the bottom of the boiler room floor beams.

Assuming that the boiler chosen is of the horizontal inclined water-tube type, with a total height of eighteen feet, and allowing the requisite space above the boiler for smoke flue and the steam piping leading from the boilers to the main header, the clear height from the operating room floor to the bottom of the roof truss will be forty feet. This gives ample space for the installation of a coal-bunker above the firing aisle.

In deciding the height of the generating room, the traveling crane and its necessary clearance of the roof truss, and especially the space required for hoisting the machinery while erecting and dismantling the turbines, have to be taken into consideration. The heaviest part of the 750-kilowatt turbines or a 1,000-kilowatt machine, which may be the future unit, may be easily handled by a ten-ton crane. As the crane is little used for the size of the plant, a hand-operated crane is sufficient. A clear space of six feet is required from the top of the runway to the bottom of the roof trusses. The elevation of the crane runway above the operating room floor will be twenty-four feet. This height of course depends entirely upon the type of turbine adopted.

The writer himself does not favorably consider some types of horizontal turbines, as manufactured at present in America (there is still much to improve upon in this country, while Europe has shown for a number of years excellent results, both in the durability and economy of operation. It is a well-known fact these turbines abroad are out of the experimental stage.) As, however, the power-plant designer does not always have his own choice, circumstances and conditions may be such that he can not select a vertical turbine, but has to accommodate his building for a horizontal type. Under this circumstance and, in order to have a proper condenser arrangement, the latter should be placed directly below the turbine in the basement, which will also contain the condenser auxiliaries, piping, etc. The height of this basement is also thirteen feet, giving a total height from basement floor to roof truss of forty-three feet. This arrangement will give the greatest convenience as both boiler room and turbine room floors are on the same level.

As the generating room and the boiler room are of different heights, as shown in the cross-section (Fig. 3), the roof trusses for both rooms must be designed separately. The extended crane columns at the division wall will support the inside ends of both roofs, the pitch of the roof truss depending upon the character of material adopted for roofing, which in the present case will be reinforced concrete covered with tar and gravel. The pitch will therefore be one inch in one foot, thus giving a height of three feet at the end walls and eight feet at the partition wall.

The coal is brought to the plant on the railroad siding and dumped into bins at the side of the boiler house. These bins run the entire length of the boiler house and are fifteen feet wide. In order to protect them from rain and snow, a light corrugated iron awning is built on a steel frame, all sides being left open so as not to obstruct the natural light of the boiler room. From here the coal is brought into the suspended coal-bunkers by means of the conveyer system. At the side of the generating room an area runs the entire length of the building in order to give sufficient light and ventilation to the basement. The wall of this area, as will be seen in the cross-section, acts as a retaining wall. In order to strengthen this wall braces are placed every sixteen feet. These braces are of concrete fifteen inches deep by eight inches wide, reinforced by two

three-quarter inch rods. Around the top of this wall is installed an iron pipe railing.

Below the basement floor, between the turbines, is a trench six feet deep by four feet six inches wide, containing the circulating water intake and discharge pipes. As the main generating room is divided by the crane columns into seven equal spaces, each about sixteen feet, and as about twenty-five feet are required for the switchboard itself (three panels), forty-eight feet in the middle of the generating room will be left exclusively for switching purposes, both in the basement and on the main operating room floor. As already pointed out, the space set apart for switching purposes is ten feet. At each side of the switchboard, symmetrically placed, are the main entrance adjoining the superintendent's office and the locker and toilet rooms, while below these rooms, respectively, are storeroom and repair shop, and the oil storage and filtering room.

LOCATION OF PLANT.

As the plant runs condensing it is of the utmost importance to locate the building as near to the water edge as possible. Therefore in choosing a site these two items should be taken into careful consideration, namely, railroad connections and convenient water supply. Further, the character of the soil is an important factor in the selection of the site, as pile-driving, excavating, blasting, etc., should not be excessive for a plant of this size. It is always a paying practice to make careful soundings and tests of the soil before the property is bought. Testing holes should be driven, according to soil, some twenty to thirty feet and even deeper. It is important to have this work carried on under skilled supervision and by one familiar with the particular locality. Test loads may be applied to determine the bearing power of the soil. In laying out the plant it is important to have the generating room lie next to the water supply where possible, in order that the condensing water intake may be as short as possible. Should the plant be situated on a residential street running parallel to the river it will be necessary to have the generating room face the street. It is further desirable, where possible, to have the generating room on the north side of the plant in order to have the best daylight.

FOUNDATION WORK.

If the site contains quicksand it should either be removed and replaced by filling, or piles should be driven, upon which a monolithic concrete mat should be laid. The latter is an expensive affair and may be accomplished either with wooden or concrete piles. In recent years it has become common practice to employ the latter, either plain concrete or reinforced, as they have a comparatively greater carrying capacity and durability, and, further, their heads may extend far above ground water. In case wooden piles are used their heads must be cut below ground water and thus deep excavation may be necessary, to which point the foundations must be carried down. If the soil should be partly of rock and partly alluvial, the latter must be carefully replaced or tamped down with layers of sand, each layer being wetted before another is applied. All rock must be cleaned before concrete is applied.

These features being satisfactorily accomplished, the size of the foundations for the various machinery and the footings for the building may be determined. In calculating the foundations for the machinery as well as for the building walls, the weight of the foundation itself must not be overlooked. The sizes of the foundations for the machinery are usually given in the manufacturer's drawings. Attention, however, must be given to secure the weight of the machinery, as the particular condition of the soil affects the size of foundation. In figuring the foundations for boilers and other similar apparatus, it is important to make allowance for the water contained therein. Two tons of total bearing load per one square foot of dry ordinary sand is considered an average figure. Each case, however, should be treated separately and the above figure should not be followed blindly.

In specifying the mixture of concrete, usually 1 : 3 : 6 is taken for machinery foundations; 1 being first-class Portland cement, 3 being clean, sharp sand, and 6 being crushed bluestone that will pass through a two-inch mesh.

Where anchor bolts have to be used for securing machinery, they must, together with the plates, be directly embedded in the foundation. Such bolts are required for the footings of the boiler and building columns and the various auxiliary machinery. The turbine itself does not need anchor bolts. At least one-half inch should be allowed for grouting after the material has been placed. The concrete forms for duplicate machinery may be used repeatedly. In placing the concrete it should not be allowed to fall more than six to eight feet, as there is liability of the stones becoming separated from the cement and being surrounded with water, thus giving a poor bond. In addition to this the concrete should be tamped.

Should the building be located where concrete is difficult to obtain and where first-class brick is at hand, these bricks should be of hard-burned clay laid in thin layers of high-grade hydraulic cement. The foundation of the building, if located below ground water level, should be provided with some sort of waterproofing. The footings of boiler and wall columns should lie below or flush with the basement floor. Attention will be called to the fact that frequently these footings are extended some three or four feet above the floor level, which is much more expensive than running the steel columns down to the floor level, and has the further disadvantages of being always an obstruction, giving many corners for the accumulation of dirt. Under these conditions it is difficult to run circulating water pipes, drain pipes, etc., at the floor level along the building wall.

SUPERSTRUCTURE.

The superstructure of the power plant should be as simple as possible, yet pleasing in appearance. Fireproof is one of the first considerations, and this is best obtainable by adopting a skeleton steel structure with concrete or brick walls. The roof, windows, doors, etc., should also be of fireproof material. The latter two items are frequently neglected in plants of the capacity here described.

As to whether a steel skeleton building should be adopted, the following items will be considered: The first cost of such a building is a small percentage more than that of a common brick or concrete building, when the latter have to carry steel roof trusses, crane runways, etc., but far greater rigidity is obtained. The installation of suspended coal-bunkers, the connection of floor frames, platforms, galleries, etc., are much more easily accomplished in a steel building. Pipe supports and anchors are easily arranged. By using a steel skeleton the thickness of the building walls will be reduced about fifty per cent. With this type of building when brick is used thirteen inches thickness will be sufficient for the walls. In monolythic concrete walls reinforced with "expanded metal" or "wire cloth," a thickness of from six to eight inches will be sufficient, provided that these walls do not, as frequently happens, act as retaining walls. This part of the wall, however, must be thicker according to the pressure of the soil. Pilasters are required to enclose the steel columns, which are set half in the walls, thus at the same time giving a

possibility for artistic design. In some localities, especially in tropical zones, it may be advisable to use corrugated iron in place of brick or concrete, on account of the frequent shocks and earthquakes. In this case it will be best to build all walls as well as the roof of the same material. This type of building, however, requires frequent painting and repairs, and is not pleasing to look upon.

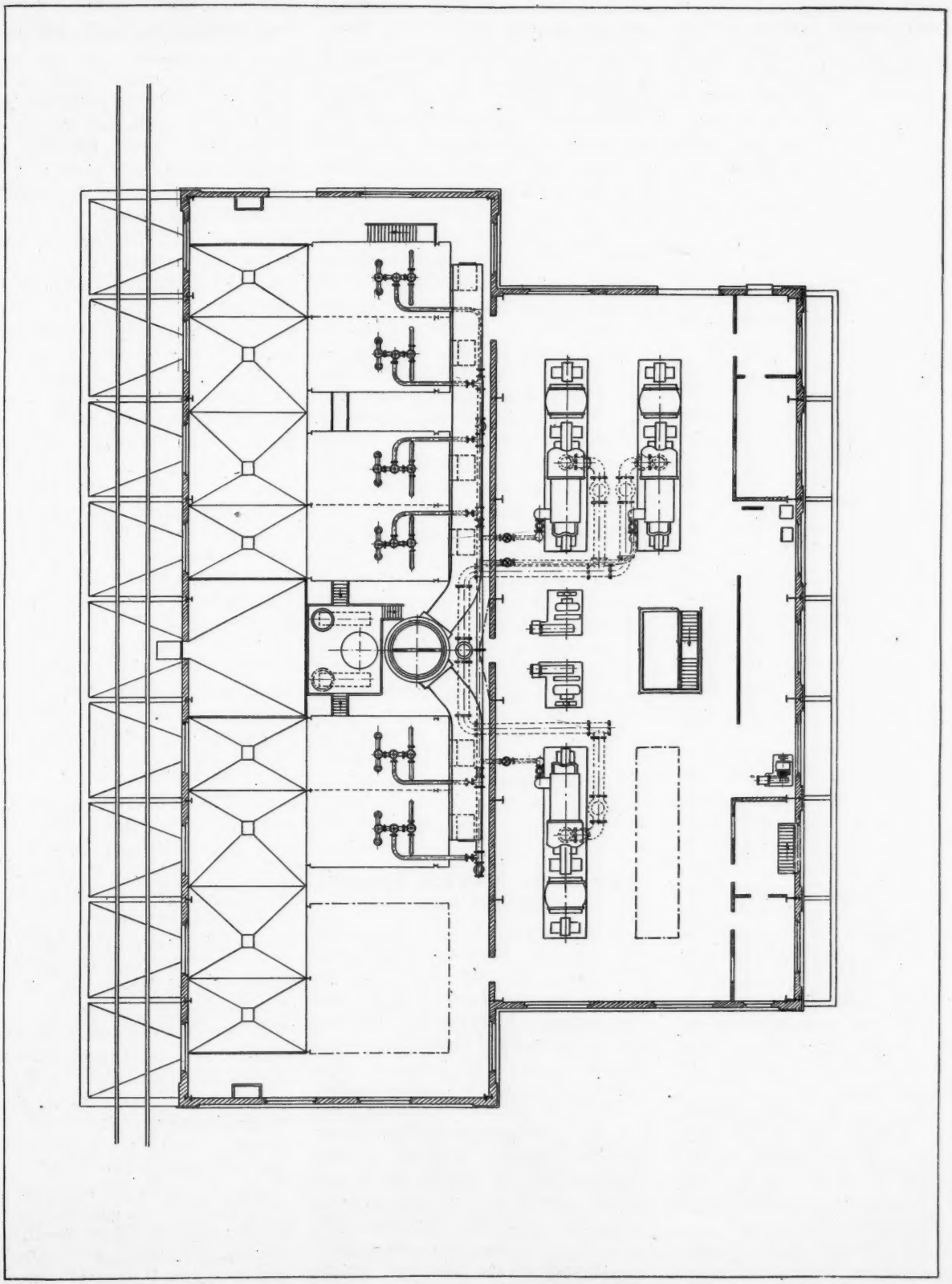


FIG. 2.—PLAN OF 1,500-3,000-KILOWATT STEAM-ELECTRIC PLANT.

The steel skeleton for the building may be either of the self-supporting type, in which case light curtain walls are used, or the walls may be self-supporting and carry the steel work. When designing the steel work proper care should be taken to secure thorough bonding of the steel work and the walls. The entire building column may be enclosed in a pilaster or only a part of it, depending largely upon the choice of building material. Brick

or monolythic concrete may easily partly or completely enclose the building columns, while in the use of the hollow concrete block it is desirable to have as few specially designed blocks as possible, and it is, therefore, important that the building columns do not break the inside lines of the walls. Anchorages may be secured by placing light rods on the extended flanges of the columns and bonding them between the concrete blocks. The various steel columns should always be of the open type and of simple design, so as to secure easy access for painting and inspection. Cross or X-bracing is frequently found between the boiler columns in the basement, but this practice is employed only by steel constructors being unfamiliar with power-house operation.

In designing the floors of the boiler and generating rooms a load factor of 250 pounds per square foot may be employed, as the entire weight of all machinery is carried by the foundations, which are built up from the basement floor. This load factor may also be applied to the switching room floor, etc. Sufficient and conveniently located stairways should be provided. Care, however, must be exercised that they do not block up passages required for the easy operation of the plant. As the condensers and various pumps are located in the basement, it is good practice to provide at least one large opening in the floor in order to facilitate removal of the machinery by means of the overhead traveling crane. This opening at the same time will give additional light and ventilation for the basement. In the case under consideration this opening will be located between turbines in front of the exciter units in the middle of the plant.

In the spacing of the crane columns care must be taken in order to secure equal spaces and symmetry in the window arrangement. As the building is 113 feet long, seven bays of about sixteen feet each will make a good layout and at the same time an economical crane run construction. As the crane capacity is ten tons, eighteen-inch beams are required for the crane runway.

It is common practice with water-tube boilers to suspend them on steel structures, which are furnished with the boilers. As, however, an overhead coal-bunker is to be installed, these front columns have to be replaced by heavier ones.

In the power plant in question it is necessary to install two bunkers, one on each side of the chimney, for each set of two batteries. These bunkers have V-shaped bottoms in order to properly empty. They have a capacity of five tons per running foot and are made up of five-sixteenths-inch or three-eighths-inch material, provided at the bottom with cast-iron outlets, to which are connected the coal "down takes" to the boilers.

The roof truss has been touched upon in determining the height of the building; it remains, however, to go more into detail. Provision has to be made for chimney, exhaust pipes and vent pipes, etc., all of which have to be provided with collars, and after the pipes have been erected, rain-hoods have to be installed. Four ventilating hoods should also be provided on the roof of the boiler room, but for the generating room such ventilators are not required, and are undesirable, as they are liable to leak, and a small leak may result in a serious shut-down of the plant. From the top of the coal-bunker to the roof itself a light plastered wall will serve to keep the dust from the boiler operating room. On one side of this enclosed coal-bunker room an iron grate walk will provide easy access to the coal conveyer system. Steel stairs and bridges will be installed between the boiler batteries, while short ladders from the boiler room will give access to the coal-bunkers. In front of the chimney, between the boilers, and some eight feet above the operating room floor, is erected on steel columns a platform twelve feet square, on which are placed a "make-up" tank, the purpose of which will be seen later, and two feed-water heaters, only one of which is placed for the present equipment. Stairways lead up to the platform and from here to the top of the boilers.

(To be continued.)

Fire at the McAdoo Tunnel Excavation.

On the morning of April 3 a fire destroyed a good portion of the temporary framework covering the area where the proposed terminal building for the McAdoo tunnels is being erected. The area affected is bounded by Church, Fulton and Cortlandt streets, New York city. The O'Rourke Construction Company, which has charge of the work, has fully 2,200 men employed in night and day shifts. The main excavation is twenty feet deep on the average. All around, however, are caissons sunk to bedrock, some of them between fifty and eighty feet down. Notwithstanding the fact that a large force was at work at the time, and the air locks were manned by numbers of the employés, everybody connected with the work was rescued with but slight injury. The total damage has been placed at $100,000.

PROTECTION AGAINST LIGHTNING AND THE MULTI-GAP LIGHTNING ARRESTER.[1]

BY D. B. RUSHMORE AND D. DUBOIS.

In considering lightning protection, the first step is naturally to study the apparatus to be protected. Then the forces to which it will be subjected, and finally the protecting apparatus. For apparatus to be protected, we have insulators, transformers, switches and generators. The specifications for dielectric strength of generators is as provided for in the standardization rules of the American Institute of Electrical Engineers. The usual specification for high tension transformers is that they shall stand from line to core twice the normal line voltage, independently of whether the transformers are "Y" or delta connected. Switches are made to stand two and one-half times normal line voltage, and insulators should stand three times the line voltage dry and one and one-half times the line voltage with a precipitation of one-fourth inch per minute at forty-five degrees. The allowable rise of potential on the line is therefore less than 100 per cent and about sixty per cent of line voltage seems a desirable point at which the protective apparatus should operate.

Protecting apparatus consists briefly of lightning arresters, horn arresters, static dischargers, choke-coils, and ground wires. Here lightning arresters are defined as apparatus that can relieve the line of high voltage without disturbing operating conditions.

Transformer Connections—From the standpoint of protection of the system from static disturbances, whether external or internal, the grounded star transformer connections with overhead ground wire offers the best conditions, and is in general recommended where other conditions do not decide. The causes of most frequent disturbances on transmission systems are short-circuits and grounds.

As regards short-circuits between wires, there is but little to choose between the star and delta connections; but as regards grounds, and especially partial grounds, the grounded star system affords a great advantage in the reduced possibility of a disastrous increase in voltage.

When a ground is formed on one line of a high-tension transmission, that line should at once go out of operation, and with a properly designed system no interference with the delivery of power should result.

All of the considerations which enter

[1] From a paper read before the American Institute of Electrical Engineers, March 29.

into the question of transformer connections are not pertinent to the question of lightning protection, but from that standpoint the grounded star system with the overhead ground wire is most desirable.

The Horn Lightning Arrester—Due to its apparent simplicity, the horn lightning arrester has of late received considerable attention. It is, however, not a piece of real protective apparatus in the sense of protecting the line without disturbing the conditions of operation. If it is used without resistance, it has the effect of a short-circuit, and with resistance high enough to prevent it from causing a great drop in voltage, the protective features are largely eliminated. It is in reality an emergency device, a weak point in the system which is the first to rupture when the voltage rises to a dangerous value, and if the system is without protective apparatus, it locates the point of breakdown when the condition is such that some failure must occur.

In general, the discharge of horn arresters without resistance will throw synchronous apparatus out of step, and necessitate starting up the system again. The voltage will drop to zero at a short-circuit, and, as the arc may last from two to three seconds, the disturbance of the system is considerable. Where a fuse is used in series with a horn having no resistance, it can, of course, take but the one stroke and after this the system is unprotected. A flaming arc in air, such as occurs with the horn arrester, is a possible source of disturbance much worse than the original one, and under certain conditions can give rise to very high voltages, so that the possibility exists that the horn, instead of being a protective feature, may become a disturbing one.

The horn arrester with sufficient resistance to prevent short-circuiting the system at time of discharge has some small protective value, which can easily be determined by the amount of resistance used.

The real function of the horn arrester is its use to protect insulators along a transmission line, where the horns are so arranged that the current will jump to the horn before it will arc around the insulator. In this case the system would be disturbed either way. Where it is allowed to arc around the insulator, the latter would probably be destroyed and the time of disturbance of the system might be considerable—possibly until the insulator is replaced. With a horn protecting the insulator, the resulting short-circuit, while very undesirable in itself, is less disastrous than in the former case, and may only necessitate starting up the synchronous apparatus again.

Many disturbances caused by atmospheric lightning are of such high frequency that they will not travel along the line for any distance, and will jump to ground within a short distance of where the disturbance originates. To protect against this, the use of horns is recommended.

Care must be taken in the formation of the horns, and it must be remembered that the magnetic effect in putting out the arc is much greater than that of the heat causing the arc to rise. By improperly forming the horns, the arc will travel down instead of up, and will not clear itself.

Protection for Wood Pole Transmission Lines—Practically complete protection for wood pole transmission lines can be effected against disturbances from atmospheric lightning by an overhead ground wire in connection with a lightning-rod and horns protecting the insulators. The overhead ground wire relieves the electrical stresses that would otherwise be thrown on the transmission line. A pipe supporting the ground wire acts as a lightning-rod, and also as a horn to the top conductor, protecting its insulator. Side horns are attached to the cross-arm, protecting the two lower insulators, and these are all well grounded by a conductor attached to the side of the pole.

Static Discharges—The new form of multi-gap arrester includes a static discharger consisting of the high resistance with the smallest possible number of gaps in series. This should offer sufficient protection against static wherever the arrester is used. There are cases, however, where the complete arrester is not thought necessary; such, for instance, as to protect underground cable systems having no exposure to lightning. In these cases the high resistance and series cylinders can be installed alone. Of course, no protection against low-frequency surges of power is secured, and if such are likely to occur the whole of the arrester should be used.

Water-Jet Arrester—What is known as the water-jet arrester has been used abroad to some considerable extent, and in certain localities has apparently obtained a reputation which it is difficult to justify.

The equivalent needle-gap and the resistance of this arrangement are so great that it is evident that no real protection is obtained by its use. Its only function can be that of a high resistance connected permanently to the line, and in this case it has the advantage of being self-repairing if ruptured by discharge. It should to some extent prevent the slow accumulation of static charges on the line. It is, however, difficult to install, and it is questionable if the same results can not better be obtained in other ways, and its use is not recommended.

Ground Wire—Without doubt an overhead ground wire affords protection to a transmission line. This protection is not complete, as a very few cases exist where insulators have been lost by lightning strokes even when a ground wire was used, but these instances are so very rare that the use of a ground wire is strongly recommended. It should, however, be installed in addition to other apparatus, and, while it will almost entirely protect the line, it does not protect the station apparatus completely.

The use of a ground wire very greatly relieves the stress which can be thrown on the station apparatus, however, and much reduces the duty required of the station lightning arresters.

A three-eighth-inch stranded steel wire, grounded at least every 500 feet, should be installed above the highest transmission wire. Experience demonstrates that this is desirable, and that a ground wire below the transmission wires or in the centre of a triangle is not as effective as one above. One ground wire is all that is necessary, although theoretically more are better.

Where a ground wire is used in connection with the grounded neutral of a star-connected high-tension system, the best results will be obtained. In some cases the ground wire is mounted on insulators and is identical with the other conductors, in which case it is possible to use it as a spare conductor after removing the grounds. In all cases, both with wooden pole transmission lines and where steel towers are used, the use of a ground wire is recommended as a protective device against the effect of lightning.

Choke-Coils—The disturbances on a system in which protective apparatus is used come from various sources and are of various characteristics as regards voltage and frequency. If our object was to protect the station against disturbances which emanate from the transmission line, high reactance might be desirable except as it interferes with the regulation of the system. When, however, the disturbance is inside the choke-coil, high reactance is undesirable. In the case of a system with large capacity, an arcing ground in series with the high reactance choke-coil may cause excessive rise of voltage. If one goes through the list of possible disturb-

ances, it is seen that in some cases high reactance in a choke-coil is desirable and in others it is equally undesirable. It is, therefore, recommended that a choke-coil be used, but that it possess but moderate reactance, sufficient to reduce the pressure thrown on the station apparatus by an amount which will in general bring it within the safe value of the dielectric strength of such apparatus. Moreover, a choke-coil to be effective at high-frequency discharges should have very little capacity between turns; otherwise the discharge will merely pass through from turn to turn. The coils should, therefore, not be too close together and should be insulated by a substance having low specific inductive capacity—air. Another advantage

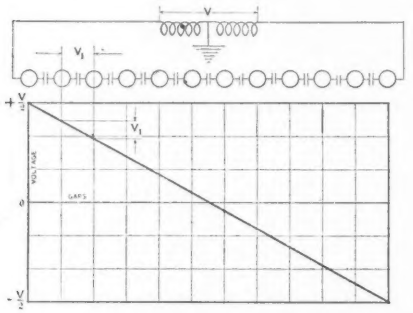


FIG. 1.—POTENTIAL DISTRIBUTION WITH CAPACITY BETWEEN CYLINDERS AND GROUND.

of air as an insulator for a choke-coil is that there is no chance of permanent short-circuit. Where ordinary insulation is used in a choke-coil, there is no way to tell that the insulation has not been destroyed. Each stroke may break down a few turns until finally the coil is punctured from end to end. At the next stroke there is trouble.

Grounds—It is of the utmost importance to have the lightning arresters well grounded. The ground wire, preferably flat copper strip, should lead directly to ground with as few bends as possible. It sometimes happens that a good ground can not be conveniently made near the arrester, or that a better one can be made at a more distant point. In this case it is recommended that the principal ground be made at the more distant point, but that a ground of some sort, the best possible under the conditions, be made directly beneath the arrester. By the use of three grounds at a station the ground resistance of each can be determined. The two secondary grounds need not be complicated or expensive; iron pipes driven into the ground will answer. A record of the resistance of the grounds can thus be kept, and their good condition assured. All three should be used in parallel.

Multi-Gap Lightning Arrester—The essential elements of the multi-gap lightning arrester consist of a number of cylinders between line and ground and line and line, these cylinders being spaced with a small air-gap between them.

The multi-gap arrester is distinguished

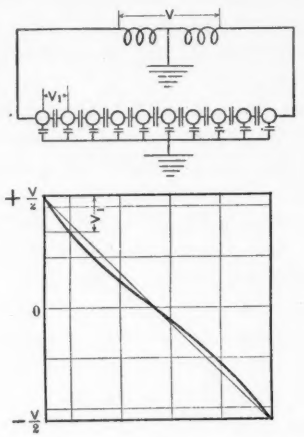


FIG. 2.—CAPACITY BETWEEN EACH CYLINDER AND GROUND.

from the single-gap arrester in that it can be made to discharge abnormal rises of potential without disturbing operating conditions. Under most conditions of its operation it discharges at a much lower voltage than does a single gap, the length of which is equal to the sum of the small gaps, and the interrupting power is such that the disturbing charge passes off without allowing the dynamic current to follow for more than one-half cycle.

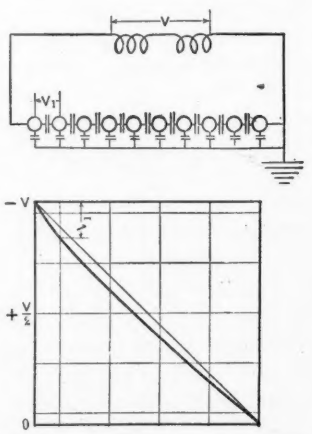


FIG. 3.—WITH ONE END GROUNDED.

As shown diagrammatically in Fig. 1 the cylinders of the multi-gap arrester act as plates of condensers in series and this condenser function of the multi-gap arrester is the essential feature of its operation.

Supposing capacity to exist between the cylinders and no capacity between cylinders and ground, if a potential is applied across the arrester, the distribution of this potential will follow a straight line law and the fall of potential will be the same between any two cylinders. If now we ground one end of this device, the distribution of potential over the cylinders remains the same in value, but the potential is all in one direction, or the whole device is raised above zero potential. However, besides the capacity between cylinders, capacity also exists between each cylinder and ground. This is shown diagrammatically in Fig. 2. The function of this second capacity is to distort the gradient. Where the number of cylinders is small, the curve showing the distribution of potential does not differ greatly from a straight line, as shown in Fig. 3.

If, instead of grounding the transformer in the middle, we now ground it at one end, the whole device is raised above zero potential and the distribution of potential over the cylinders is as shown in Fig. 3, where the curvature is in the same

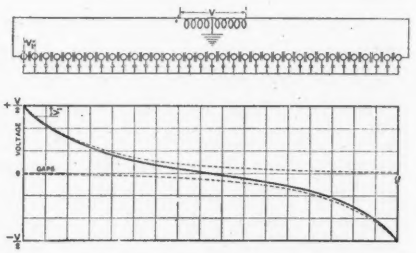


FIG. 4.—POTENTIAL GRADIENT, GROUNDED.

direction throughout but again not differing greatly from a straight line.

Where we have a large number of cylinders, the conditions are somewhat changed. If we have a device as shown in Fig. 4, which is supposed to represent a large number of cylinders connected across a transformer with grounded neutral, the distribution over which is shown, it will be noted that this curve differs considerably from a straight line. In this case there is a part of the apparatus in the middle where very small difference of potential exists between the cylinders, and the fall of potential at the end cylinders is much greater than that which exists between the cylinders nearer the middle. The distribution of potential over the device exhibits the general form of combination of an exponential function opposite sign as shown in the sketch. If one end of the transformer is grounded instead of the middle, we have the distribution of potential shown in Fig. 5. It will be noted that the drop of potential over the end cylinders, as shown in V^1, Fig. 5, is very much greater than that shown in V^1, Fig. 4, the voltages between lines being the

same. If this potential drop reaches a certain value, a discharge across the cylinders takes place. With a large number of cylinders, therefore, a voltage which could not break through when the system was grounded in the middle may be high enough to break through when one end is grounded.

It will be seen that the potential between the first and second cylinders in Fig. 5 is much greater than between the second and third, etc., from which it is evident that this arrester breaks down in successive steps. At a certain voltage across the arrester, the potential gradient between the first and second cylinders is sufficient to break down the dielectric between them. The potential of the second cylinder then, being connected to the first by an arc, rises, and may rise to such a point that it breaks down to the third cylinder, and the third to the fourth, and so on till the arc has passed entirely across the arrester; then the line current starts flowing across and the distribution of potential is changed, following now a straight line as shown. The potential difference between all cylinders is then the same, and becomes much less than in the case before a breakdown. It is well known that to maintain an arc of alternating current across a gap the voltage must be at least high enough to re-break down the dielectric each time after the arc goes out at the end of a half-cycle. The dielectric is greatly weakened by the heat produced by the passage of the arc, therefore the voltage to maintain the arc need not be as high as that which originally broke across.

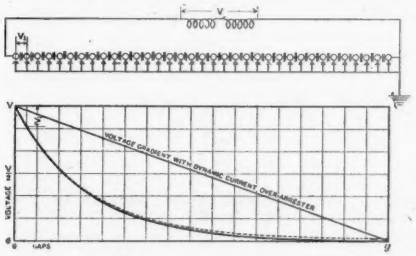


Fig. 5.—Potential Gradient, Grounded.

The arresters are designed so that the voltage gradient shown by the straight line in Fig. 5 is not steep enough to give a voltage across the gaps high enough to maintain an alternating-current arc. An arc following a discharge across the arrester would therefore go out at the end of the half-cycle in which it occurred.

Fig. 6 shows the distribution of potential over the arrester with one line grounded, where breakdown occurs over a number of gaps without a complete discharge. This is one of the phenomena of multi-gaps. It will be noted that the potential gradient between the first two cylinders begins in this case at a point greater than the spark voltage, and that when this gap breaks down a new gradient is then established from cylinder No. 2, which, although not so steep as that from No. 1, still breaks down the gap to No. 3; thus the successive gaps break down until a gradient is reached less than the spark voltage. The reason for the decrease in gradient is as follows: When breakdown occurs from one cylinder to another, the second cylinder is charged to the potential of the first, less the drop in voltage due to the arc. The current which flows across the gaps in this arc is, of course, small. It is made up at the normal frequency charging current and the charging current necessary to raise the gradient to its new position. On low frequency this last is most important. Due to the drop in voltage as the successive cylinders break down, the current through the arcing gaps also decreases, the gradient of drop in voltage following a curve. If the potential gradient as the arrester breaks down from one cylinder to another does not reach a value less than that of the spark voltage, the breakdown of the arrester is complete and discharge passes entirely across the apparatus. This means that either the voltage was higher at the start than in Fig. 6, or that the drop in voltage between the gaps was less. This is shown clearly in Fig. 7, which also indicates in the most interesting manner the difference due to the effect of frequency, which is a very important factor with the multi-gap lightning arrester. When the breakdown occurs from the first to the second cylinders, the potential of the second cylinder depends upon the amount of current which passes. As this current is that due to the capacities which have been considered, it will be greater at high frequencies and the fall of potential between the first and second cylinders will therefore be less. As the arrester gaps break down successively, the fall of potential from one cylinder to another is less, and therefore such an arrester will discharge at a lower voltage for a higher frequency than for a low. At high frequency, due to the inductance of the cylinders themselves, the normal gradient is steepened; this also assists breakdown. In such cases where the arrester discharges completely, no point is reached where the potential gradient is less than that of the spark voltage.

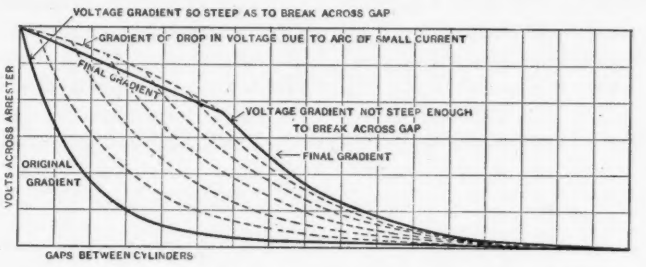

VOLTAGE GRADIENT SO STEEP AS TO BREAK ACROSS GAP
GRADIENT OF DROP IN VOLTAGE DUE TO ARC OF SMALL CURRENT
FINAL GRADIENT
VOLTAGE GRADIENT NOT STEEP ENOUGH TO BREAK ACROSS GAP
FINAL GRADIENT
ORIGINAL GRADIENT
VOLTS ACROSS ARRESTER
GAPS BETWEEN CYLINDERS

Fig. 6.—Distribution of Potential Over Arrester with One Line Grounded. Breakdown Over a Number of Gaps Without Complete Discharge.

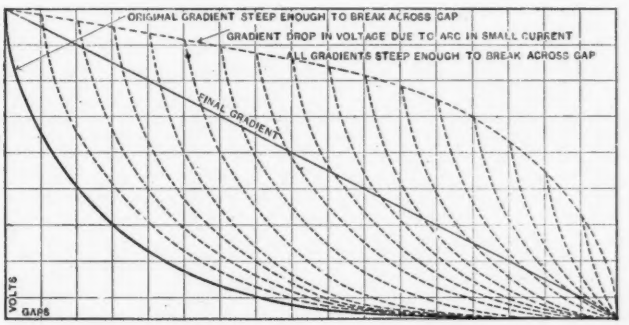

ORIGINAL GRADIENT STEEP ENOUGH TO BREAK ACROSS GAP
GRADIENT DROP IN VOLTAGE DUE TO ARC IN SMALL CURRENT
ALL GRADIENTS STEEP ENOUGH TO BREAK ACROSS GAP
FINAL GRADIENT
VOLTS
GAPS

Fig. 7.—Complete Breakdown, Low Frequency.

As is well known, the multi-gap arrester without resistance discharges more easily at high frequencies than at low. By properly designing the resistance this can in a large measure be overcome, so that the arrester will protect equally well at one frequency as at another.

In the same way that high frequency lowers the breakdown of multi-gaps by increasing the current of the spark, high resistance, by absorbing voltage when this current flows, decreases breakdown. Re-

sistance is more effective at high frequency in increasing breakdown voltage, as at high frequency the charging current is higher and therefore there is more voltage drop in the resistance.

Resistance—Resistance is one of the important factors of lightning-arrester construction. Its usual functions are, in general, 1, to limit the current, 2, by shunting part of the arrester to give fewer gaps for low frequency to break across.

Series resistance limits the current under all conditions, but, although in this way protecting the arrester, it is dangerous in case of a surge. It has still another and perhaps worse effect. All resistance is more or less inductive, and in case of high-frequency stroke, series resistance will prevent free discharge and tend to reflect the disturbing wave. With series resistance the arrester may have all the optical appearance of discharging freely and may puncture test papers, while its real value as a protecting device is not indicated in any way.

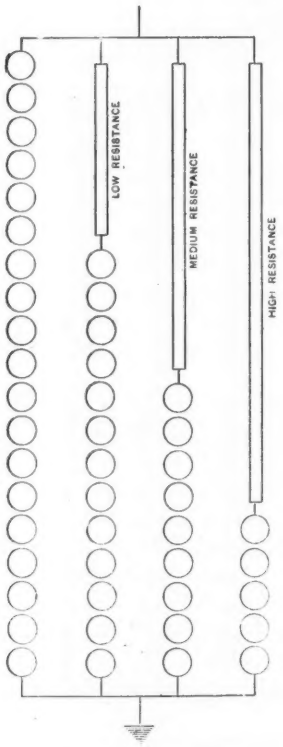


FIG. 8.—GAPS AND RESISTANCE ARRANGEMENT FOR ANY FREQUENCY.

The desirable characteristics of resistance are as follows, it being impossible to obtain them all in any one known combination:

1. Sufficient heat-absorbing capacity,
2. Surface of such character that arc will not flash over,
3. Must be easily replaceable,
4. Non-absorptive as regards moisture,
5. Uniform conductivity over section,
6. Non-inductive and straight,
7. Should have no coherer action,
8. Sufficient mechanical strength to stand red heat without failing,
9. High specific resistance,
10. Resistance should not change with use,
11. Must not become incandescent under service conditions,
12. Must allow of good contacts.

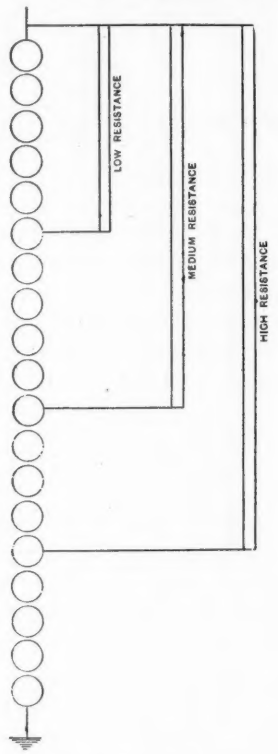


FIG. 9.—ARRANGEMENT OF GAPS AND RESISTANCE TO DISTRIBUTE CURRENT AND RELIEVE LINE.

Ideal Lightning Arrester—The ideal lightning arrester should prevent any rise of voltage dangerous to insulation. It should offer a free path of discharge from line to ground and from line to line, and should perform its functions without disturbing the operation of the system. It should put out the arc at the end of the half-cycle in which it starts, and should have no discrimination in its protective power as regards the frequency of the disturbance. That is, it should discharge at a certain voltage for any frequency. An arrangement of gaps and resistance as shown in Fig. 8 meets this last condition, in this way; gaps alone break down more easily at high frequencies, but high frequencies will not readily break down through both resistance and gaps. Low frequency is not impeded as much by resistance but can break through only a few gaps for the same voltage compared with high frequency. For a given voltage, then, the higher frequencies would break through the path with gaps only; frequencies somewhat lower, through the path with moderate resistance; and low frequency and accumulated static through the path with the high resistance. An arrester of this type, however, possesses the disadvantage that after a voltage of low frequency breaks across the gaps in series with the high resistance, the current which can follow can not relieve the line. This can be overcome by an arrangement such as shown in Fig. 9. In this case the same paths of breakdown for the different frequencies are retained, but now if low frequency breaks down the gaps in series with the high resistance, the entire voltage less that consumed in the arcing gaps is concentrated across the next highest division of gaps. These, if correctly designed, will at once break down, passing the strain still further up the arrester, and so on, the arrester breaking down in sections until it is either completely broken down or the line voltage has been lowered by the current flowing through the resistance.

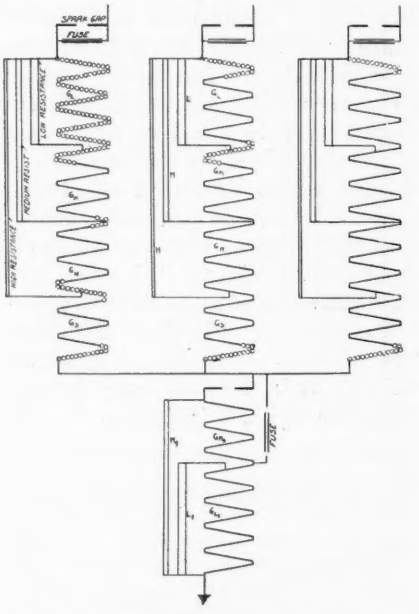


FIG. 10.—ARRANGEMENT OF ARRESTERS FOR 35,000 VOLTS.

The arrangement for these arresters for 35,000 volts is shown in Fig. 10 for the delta and ungrounded star transformer connection. Each leg is connected to one of systems. Each leg is connected to one of the lines through a spark gap, shunted by a fuse. Connected in just below the

fuse is a novel device, in that there are the three resistances in parallel, tapping in to different parts of the leg as shown. These three line legs are joined at their lower ends by a common or multiplex connection, from which, for ungrounded systems, a fourth leg connects to the ground. In the arrester for grounded star systems no fourth leg is added, the multiplex connection being connected to ground.

Fuses—The use of a fuse in shunt with a spark-gap is for the condition of continuous high voltage on the lines from any cause, an arcing ground or otherwise. The fuse will then blow and it will throw the gap in series with the arrester and

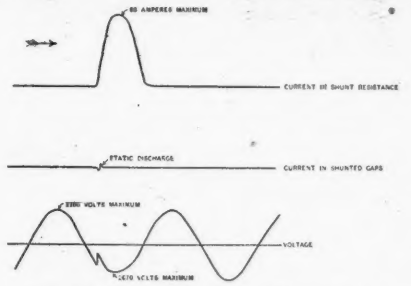


FIG. 11.—OSCILLOGRAM OF DISCHARGE PHENOMENON.

thus bring about an automatic adjustment of the gaps. This allows the arrester to be adjusted to discharge at but a small percentage above the line voltage, and thus to afford real protection. The introduction of the extra gap does not destroy the arrester as a protective device; it merely adds a factor of safety against the destruction of the arrester. If this fused gap were omitted, its equivalent would have to be introduced as additional multi-gaps. This fuse is so proportioned that it will

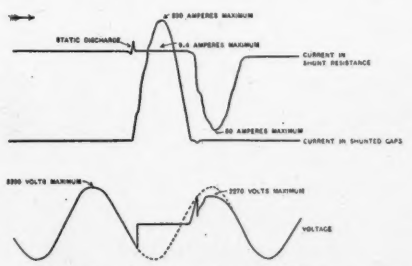


FIG. 12.—OSCILLOGRAM OF DISCHARGE PHENOMENON.

not blow at an ordinary discharge. The small complication of the addition of this device is much more than offset by the close adjustment possible in the arrester, thus allowing the best protection to be had.

Resistances—The three resistances designated respectively L, M, and H for low, medium, and high, represent a distinct advance in the art of lightning-arrester design.

Lightning arresters of the form shown in Fig. 10 have been designed for the following voltages: 6,600, 10,000, 12,500, 15,000, 20,000, 25,000, 30,000, 35,000, 40,000, 45,000, 50,000, and 60,000 volts. Anything between these voltages is, of course, taken care of by the arrester on one side or the other, as is thought best. For lower voltages, down to 500 volts, the arresters are of slightly different design, having only two resistance rods. For voltages below 500 volts, no resistance is necessary, as the voltage is so low that the arc can never hold. These arresters, therefore, consist simply of single spark-gaps to be connected directly across the line. The 2,300-volt arrester consists of fourteen cylinders, nine of which are shunted by a low resistance and eleven by a high resistance.

Fig. 11 shows an oscillogram of a discharge of this type of arrester. It is seen that the only current in the shunted gaps is the current of static discharge. It should be noted that the current shown is not a measure of the true current, as the oscillograph can not respond to currents of such high frequency. Fig. 12 shows an interesting oscillogram. Here both the total number of gaps and the shunted gaps were reduced to a point considerably below the safe limit. The static discharge was at once followed by a half-cycle of short-circuit current across all the gaps, voltage falling almost to zero. The following half-cycle, however, shows that the current left the shunted gaps and flowed through the resistance, extinguishing entirely after the end of this half-cycle. With the small number of gaps used, if it had not been for the resistance the arc would have undoubtedly held and the arrester would have been destroyed. This merely shows the protection offered by a shunt resistance a step below that designed. In a correct design, the dynamic could not have started across the shunted gap in this way, and the total number of gaps is sufficient to extinguish the arc of short-circuit, even with no resistance.

Annual Convention of the American Street and Interurban Railway Association.

The annual convention of the American Street and Interurban Railway Association will be held at Atlantic City, N. J., Monday, Tuesday, Wednesday, Thursday and Friday, October 14, 15, 16, 17 and 18. This convention will include the annual meetings of the Accountants', Engineering, Claim Agents' and Manufacturers' associations. The dates upon which the different associations will hold their meetings have not been announced.

The exhibit of the Manufacturers' Association will be held on the steel pier.

Committees of the Underwriters' National Electric Association.

The following committees have been appointed as a result of the recent meeting of the Underwriters' National Electric Association:

Committee on Transformers (Rule 13)—C. H. Hill, chairman, 316 Walnut street, Philadelphia, Pa.; H. R. Sargent, General Electric Company, Schenectady, N. Y.; Dana Pierce, 382 Ohio street, Chicago, Ill.

Committee on Rule 24S—Ralph Sweetland, chairman, 55 Kilby street, Boston, Mass.; J. E. Cole, 11 Wareham street, Boston, Mass.; G. E. Bruen, 32 Nassau street, New York, N. Y.

Committee on Rules 24A-25 and 49A—Dana Pierce, chairman, 382 Ohio street, Chicago, Ill.; G. E. Bruen, 32 Nassau street, New York, N. Y.; G. S. Lawler, 31 Milk street, Boston, Mass.

Committee on Mercury Vapor Lamps—J. C. Forsyth, chairman, 32 Nassau street, New York, N. Y.; E. A. Fitzgerald, Box 298, Syracuse, N. Y.; Wm. McDevitt, 131 South Fourth street, Philadelphia, Pa.

Committee on Laboratory Report on Condulets—E. V. French, chairman, 31 Milk street, Boston, Mass.; F. E. Cabot, 55 Kilby street, Boston, Mass.; C. M. Goddard, 55 Kilby street, Boston, Mass.

Committee on Slow-Burning Wire—F. E. Cabot, chairman, 55 Kilby street, Boston, Mass.; H. O. Lacount, 31 Milk street, Boston, Mass.; A. M. Schoen, 339 Equitable Bldg., Atlanta, Ga.

Committee on Rule 64, Signaling Systems—F. E. Cabot, chairman, 55 Kilby street, Boston, Mass.; Ralph Sweetland, 55 Kilby street, Boston, Mass.; E. A. Fitzgerald, Box 298, Syracuse, N. Y.; C. H. Hill, 316 Walnut street, Philadelphia, Pa.; C. J. H. Woodbury, 125 Milk street, Boston, Mass.; F. W. Jones, 253 Broadway, New York, N. Y.; C. C. Johnson, 195 Broadway, New York, N. Y.

Committee on Recodification of Code—C. M. Goddard, chairman, 55 Kilby street, Boston, Mass.; H. O. Lacount, 31 Milk street, Boston, Mass.; J. E. Cole, 11 Wareham street, Boston, Mass.; W. H. Blood, Jr., 84 State street, Boston, Mass.; E. McCleary, 213 Jefferson street, Detroit, Mich.

Committee on Specifications for Electric Cranes—G. S. Lawler, chairman, 31 Milk street, Boston, Mass.; J. G. Emery, Jr., Shaw Electric Crane Company, Muskegon, Mich.; A. G. Wilbor, 5 Haynes street, Hartford, Ct.

Committee on Grounding Systems for

Protection Purposes (Under Rule 13A)—C. M. Goddard, chairman, 55 Kilby street, Boston, Mass.; F. E. Cabot, 55 Kilby street, Boston, Mass.; E. V. French, 31 Milk street, Boston, Mass.

Committee on Rule 2A—G. E. Bruen, chairman, 32 Nassau street, New York, N. Y.; Arthur Williams, New York Edison Company, 55 Duane street, New York; F. A. C. Perrine, 49 Wall street, New York, N. Y.

Committee on Rules and Specifications for Fan Motors—G. E. Bruen, chairman, 32 Nassau street, New York, N. Y.; J. C. Forsyth, 32 Nassau street, New York, N. Y.; W. H. Merrill, Jr., 382 Ohio street, Chicago, Ill.

Committee on Fixtures for Lighting Telephone Switchboards—R. P. Strong, chairman, 809 Hibernia Bldg., New Orleans, La.; W. H. McDonald, 703 Wilder Bldg., Rochester, N. Y.; W. S. Boyd, 382 Ohio street, Chicago, Ill.

Committee on Switches and Cutouts—H. O. Lacount, chairman, 31 Milk street, Boston, Mass.; Dana Pierce, 382 Ohio street, Chicago, Ill.; J. E. Cole, 11 Wareham street, Boston, Mass.; Ralph Sweetland, 55 Kilby street, Boston, Mass.; F. E. Cabot, 55 Kilby street, Boston, Mass.

Committee on Street Railway Property, Including Rolling Stock—Ralph Sweetland, chairman, 55 Kilby street, Boston, Mass.; Wm. McDevitt, 131 South Fourth street, Philadelphia, Pa.; R. E. Loomis, 19 Liberty street, New York, N. Y.; F. T. Sloane, 85 Clinton street, Brooklyn, N. Y.; O. B. Johnson, 55 Kilby street, Boston, Mass.

Committee on Variable Speed Motors—H. O. Lacount, chairman, 31 Milk street, Boston, Mass.; C. E. Skinner, Westinghouse Electric and Manufacturing Company, Pittsburg; H. R. Sargent, General Electric Company, Schenectady, N. Y.

Committee on Theatre Wiring—J. E. Cole, chairman, 11 Wareham street, Boston, Mass.; H. C. Harris, Columbus, Ohio; W. D. Carroll, City Electrician, Chicago, Ill.

Committee on Rheostat Rules and Specifications—G. E. Bruen, chairman, 32 Nassau street, New York, N. Y.; J. C. Forsyth, 32 Nassau street, New York, N. Y.; A. R. Small, 382 Ohio street, Chicago, Ill.

Committee on Rules and Specifications for Metal Moldings—A. M. Paddon, chairman, 434 State street, Schenectady, N. Y.; J. E. Cole, 11 Wareham street, Boston, Mass.; Wm. McDevitt, 131 South Fourth street, Philadelphia, Pa.

Committee on Specifications for Electric Signs—J. C. Forsyth, chairman, 32 Nassau street, New York, N. Y.; W. H. Merrill, Jr., 382 Ohio street, Chicago, Ill.; J. R. Strong, 35 South William street, New York, N. Y.; H. S. Wyncoop, Municipal Building, Brooklyn, N. Y.

Committee on Rules for Circuit-Breakers with Motors—A. M. Schoen, chairman, 339 Equitable Bldg., Atlanta, Ga.; Arthur Lewis, Wilkes-Barre, Pa.; J. S. Meade, 316 Walnut street, Philadelphia, Pa.

Committee on Service Wires (Rule 12A)—Ralph Sweetland, chairman, 55 Kilby street, Boston, Mass.; W. H. Blood, Jr., 84 State street, Boston, Mass.; C. H. Hill, 316 Walnut street, Philadelphia, Pa.

Illuminating Engineering Society.

A meeting of the New York section of the Illuminating Engineering Society was held at the Edison Auditorium, New York city, on Friday evening, April 12, and an informal discussion held on various topics.

The meeting was opened by Dr. Clayton H. Sharp, president of the society, who called attention to the need for increasing the membership, in order to put the society upon a substantial basis.

The first topic to be taken up was, "To What Extent in Practice Can the Distribution of Light About a Lamp be Modified by Reflectors or Globes?" This was opened by V. R. Lansingh, who, by means of a large number of lantern slides, showed the distribution of light about lamps of various types, and the modifications which could be effected by means of the many types of shades and reflectors now available. In general, the narrower reflectors give a wide distribution of light, and the wider ones give a more concentrated result. In his remarks, Mr. Lansingh called attention to the necessity for keeping glassware clean, as if dust be allowed to collect upon it, a decrease in the efficiency of about twenty-five per cent may easily result.

A communication was read from Major E. L. Zalinski, discussing the action of diffusing reflectors. These, in general, give a wider distribution of light within the reflector itself before being coated. One of the recent developments has been the use of a porclain diffusing reflector immediately above the glass reflector itself.

Dr. Louis Bell discussed the effect of the shape of globes and reflectors, and showed why a frosted surface would tend to give a wider and softer distribution of light than a clear surface. In general, however, the two effects of pure reflection and dispersion are present, though to varying degrees.

Preston S. Millar showed how a different distribution of light would be found by measurements taken around a reflector, though at different distances. He showed also curves illustrating the effect of a frosted globe placed around a discolored incandescent lamp. It had been suggested that somewhat the same effect might occur here as was found when the lamp itself had been frosted—that is, a considerable decrease in the amount of light, due to absorption by the deposit of carbon. It was found that in this particular the effect with the globe was small, probably not more than one per cent.

The second topic, "Standards of Light, Primary and Secondary," was discussed briefly by J. E. Woodwell, who referred to the work of the Bureau of Standards, Washington.

The third topic, "The Comparative Rating of Inverted and Upright Gas Lamps," was introduced by P. S. Millar, who commented upon the present methods. The situation is bad, and some consistent method is very desirable.

E. Y. Porter said that he believed the day was not very far distant when lighting companies would sell illumination instead of gas and light. He suggested that a light meter of some kind, depending perhaps upon the action of selenium, might be installed, by means of which the light actually delivered could be measured.

E. L. Elliott said that the custom of rating lamps by means of their horizontal candle-power was bad. The incandescent lamp companies are trying to get around this by rating the lamps according to the energy of consumption, but this is really begging the question. The same is true of the method of furnishing light by means of gas. He thought that this matter should come up before the committee on nomenclature and standards, and a more satisfactory state of affairs might thus be brought about.

The fourth topic was, "Is It Desirable to Mix Different Colors of Light and Kinds of Illuminants in Store Lighting?" The discussion was opened by E. Y. Porter, who said that it never was desirable, that the conditions existing in any room or building should be considered and the best type of illuminant for that particular place be decided upon. This, then, should be installed alone. He referred to a building in Newark where several types of electric lamps are employed. Each set accentuates the peculiarities of the others, and this produces a disagreeable effect.

W. H. Gardiner, Jr., agreed with Mr. Porter that different kinds of lamps should never be mixed, but this is usually done because the kind of light given by one lamp is most suitable for some particular part of the room, while that from another satisfies better elsewhere.

The meeting was then adjourned.

The Dedication of the Engineering Societies Building.

Professional Sessions of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers. Formal Receptions by the Founder Societies and by the Associated Societies Having Headquarters in the New Building.

THE formal exercises incident to the dedication of the Engineering Societies Building, 29-33 West Thirty-ninth street, New York city, were begun rather informally by a special meeting of the American Institute of Electrical Engineers, held in the auditorium of the building on Monday evening, April 15. The paper of the evening was presented by Louis M. Potts, and was entitled, "The Rowland Telegraphic System." President Sheldon called the meeting to order and announced a statement from the secretary, which would be followed by a statement from the chairman of the Institute Land and Building Fund Committee, T. C. Martin.

Secretary Pope extended an invitation to every one present to inspect the Institute headquarters on the tenth floor.

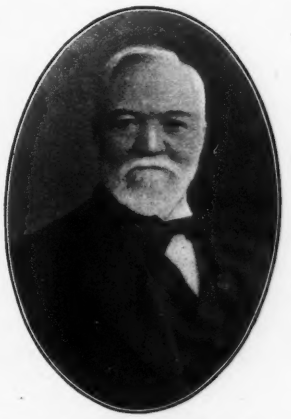
Mr. Martin then announced that when the Engineering Societies Building project was taken up in earnest a short time ago, and the Institute found itself responsible for its fair share of the cost of the land, there was a debt of $185,000 facing the members. He could report, as a result of the labors of the Land and Building Fund Committee, pledges amounting to $165,000, of which $125,000 has been paid. With the balance on hand, the Institute could face dedication day with a clear title. "But," said Mr. Martin, "the Institute balance is sacred, and should be so regarded by all the members. Now, there are a great many of the members who have not made either contributions or pledges. It is for these members to take a quick interest in the matter and give their financial support to this enterprise, so that the Institute may shortly complete its entire subscription of $185,000, and have a considerable surplus, leaving the Institute balance intact."

President Sheldon said that it gave him a great deal of pleasure to present to the Institute one of its honorary members, a past-president of the Institution of Electrical Engineers of Great Britain, a man who had taken a great deal of interest in the American Institute of Electrical Engineers, and one who had attended its first session; a man who had been looked up to as the fountain-head of information for many years, and one who had devoted his life to developing the telegraphic industry.

Sir William Preece received a very hearty expression of welcome from the members present, and, in response, stated that of all the honors which had been conferred upon him, none gave him greater pride than to preside as chairman over a meeting of the American Institute of Electrical Engineers. He then called upon Mr. Potts to read his paper.

Mr. Potts abstracted his paper, passing over the details of construction and dwelling simply upon the essential points.

The Rowland telegraphic system combines the two features of multiplexing and printing. The multiplexing is accomplished by the synchronous operation of



ANDREW CARNEGIE, DONOR OF THE ENGINEERING SOCIETIES BUILDING.

instruments at the terminal stations. In an octoplex installation, each of the four operators is given the use of a telegraph line one-fourteenth of a second, at intervals recurring three and one-half times a second. The printing is accomplished by a direct method, no punched or otherwise prepared tape being used either at the receiving or sending stations. The apparatus includes means for shifting the telegraph blank, for changing the position of the carriage, and for moving the blank entirely away from the printing mechanism when a new message is to be recorded.

The theoretical maximum speed is about forty words per minute. On account of the time required for returning the carriage to the beginning of the line when operating for long periods, the speed in actual practice is about thirty-five words per minute. Upon a basis of thirty words per message, which is generally accepted as a fair average, this speed is equivalent to a rate of about seventy-five messages per hour per operator, or 300 in each direction per hour per wire, or 600 per hour per wire for full octoplex.

In the Rowland system of telegraphy the basis of the telegraphic current is an alternating current. In an octoplex installation the current at the normal speed of operation has a period of ninety-eight cycles per second. The same current is used for signaling and synchronizing. The alternating current is sent over the line continuously. The signals consist in reversing certain combinations of waves.

The author concludes that the most important practical requirements of telegraphic service are accuracy and promptness. In the Morse system the presence of the human element in every operation necessarily introduces corresponding inaccuracies. In the Rowland system the human element is reduced to a minimum by keyboard transmission and automatic reception. The printed local record before the Rowland operator, too, shows what has been transmitted and furnishes the operator an immediate method of checking the message sent. The octoplex wire capacity of the Rowland, and direct transmission from typewriter keyboards, with direct reception in printed characters on regular telegraphic blanks, ready for immediate delivery, constitute the best possible combination to insure promptness.

The author claims that the efficiency of a Rowland operator is practically double that of a Morse operator. To transmit a Morse message, two skilled operators are necessary, while to transmit a Rowland message one typist is necessary. The sole requirement that the operator shall be a typist and able to transmit a message intelligently greatly broadens the labor field and permits the economies incident to such an increased supply.

Sir William called upon Ralph W. Pope to open the discussion. Mr. Pope first expressed for the members the appreciation which was felt at the signal honor conferred upon the Institute in having Sir William for its chairman upon this occasion.

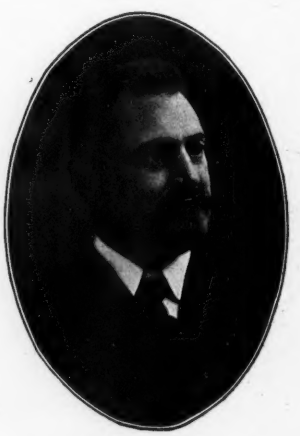
In considering the paper of the evening, Mr. Pope said that one of the first things we must do is to divest ourselves of the

opinion that anything that would supersede the Morse would be welcome. The fact that the Morse now is and has stood its ground with hardly any change whatever for so long a period demonstrates its practicability and indicates that it will prevail. Mr. Pope indulged in some very interesting reminiscences concerning the early operators' work with the Hughes, the House and the Bain printing telegraphs. These had all come and gone, and the manual system of Morse telegraphy had overcome each of them in turn. A few days ago Mr. Pope, in company with other members of the Institute, had had the pleasure, through the courtesy of Francis W. Jones, chief engineer of the Postal Telegraph-Cable Company, of witnessing the operation of the Rowland system on a line between New York and Boston. This test was conducted under severe conditions, as the weather in the territory through which the line ran was very bad. A message of reasonable length was transmitted to Boston and repeated back to New York, sent and delivered in five minutes. Mr. Pope was of the opinion that there would not be the saving in the labor cost that the author of the paper indicated. When earlier printing telegraphs had been put in use, only the most skilled and highest-priced experts were assigned to their operation. It was a mistake to think that because the message could be sent by depressing the keys of a typewriter that any fool could become a telegraph operator. The Rowland system of telegraphy was most beautiful, the apparatus was remarkable in its work, and for trunk line business, where high pressure prevailed at all times, the machine would undoubtedly have an application; but on way business and for a great many kinds of service the manual system would, in his opinion, always be found to be applicable because of its greater simplicity.

Dr. A. E. Kennelly was then called upon. He thought it remarkable that although so many electrical applications had developed so rapidly that the telegraph has almost stood still. While many considered that it had been marking time for years, some had felt that it had not kept up with the march of progress. However, it was the only system which had stood its ground, literally. The telephone had been driven off the earth, the electric-lighting systems had been driven off the earth, as had also the electric railway systems. The telegraph, however, still maintains the earth as part of its circuit, although it is more and more feeling the influences of static stresses, and is being affected by vagrant currents from other systems of electrical operation. From the evidences at hand to-day it seemed that rock bottom had been reached in the matter of telegraph economies. The price of materials had advanced, and the cost of labor was also very high. Some form of automatic telegraphy must be devised to supersede the Morse under those conditions where it would be found applicable. The system under discussion was ideal if the inertia of the moving parts could be reduced so that the high-speed characteristics could be maintained under all conditions.

CHARLES F. SCOTT, CHAIRMAN CONFERENCE COMMITTEE.

William Maver, Jr., then addressed the meeting. He thought the degree of success which had been reached with the Rowland, the Buckingham, the Murray and the Barclay systems highly encouraging. He often wondered what had set Professor Rowland to work upon this system of multiplex telegraphy. He had heard that one inventor had spent $150,000, and that, up to date, $9,000,000 had been expended in trying to develop automatic printing telegraph systems. To-day the Rowland system is in a very fair state of practical operation. Qualifications, however, are necessary regarding its efficiency. The system has not been tried on very long lines, and its speed characteristics would change if it were. The system would undoubtedly need modification if applied to the New York-Chicago line. As Mr. Pope said, it was not applicable to way wires. There was no question, however, as to its utility for the purposes to which it has already been applied. He thought that, of the automatic systems, the Murray would be the best for long distances, and the Rowland for short distances. Disagreeing with the author's ideas concerning the elimination of the skilled operator, Mr. Maver called attention to the value of the skilled and intelligent Morse operator in checking errors which were introduced because of unbalancing influences—that is, the sending operator might put on the wire a perfectly coherent message, but the influences operating against the wire might affect the message as received. In many cases the alert Morse operator made sense out of the received message where a person of less intelligence would have failed entirely. However, the Rowland system had a field. Its engineers were to be congratulated. It would be tried out and opportunities for improvement would doubtless be found.



JOHN W. LIEB, JR., CHAIRMAN DEDICATION COMMITTEE.

H. G. Stott spoke briefly concerning the dearth of papers before the Institute upon telegraphic subjects. He thought that possibly the reason why the advance had been so slow was because so little interest had been shown in the subject.

E. F. Northrup called attention to the fact that it was six years ago the next morning, Tuesday, April 16, that Professor Rowland had died. He had been associated with Professor Rowland when he began to take an interest in multiplex telegraphy. He had had the great pleasure of working with him for three years. Mr. Maver had raised the question as to why Professor Rowland had taken up this matter. He could answer this question. Professor Rowland had a disease which he knew would kill him. He had often remarked that there were many beautiful problems in physics which he would like to work out, but that he felt that it was his duty to leave a heritage to his family. Rowland was one of the bravest souls the world has ever known. He worked upon

this system practically up to the day he died. Three days before his death he sent a note from his sick-bed to his laboratory suggesting the incorporation in the patent claims of some of the most important features of his invention. The Rowland system differed from other automatic systems in that it was a kinetic system, as against a static system. Current was passing over the line at all times, with the paradox that if signals were sent simultaneously from each end of the circuit that there was no current on the line at that time. He thought the author had not given sufficient emphasis to the feature of flexibility which was inherent in the Rowland system. Professor Rowland, before his death, laid the basis for an infinite flexibility in the distribution of messages through the use of alternating-current telegraph systems.

Gano S. Dunn said that there was a subtle something which bound all telegraphers together. He paid a tribute to the industry which had made possible for him a college training, and had taken him from the dingy office, where the messenger boys congregated, and given him the opportunity of becoming a part of the splendid organization which was represented by the American Institute of Electrical Engineers. He could not help dwelling upon the fact that a great many of the men who had been responsible for the developments in electrical engineering of every description had had their start as telegraphers. The statements set forth in the paper of the evening, he thought, should be qualified. If the public at large should read that such an increase in the rate of transmission were possible they would want to know how soon it would be when rates would again be lowered, under the circumstances. The system was beautiful, but its application would be principally for that class of business upon which no increase in rates has been considered. He thought that the opportunity for the use of the automatic system was demonstrated by the conditions existing to-day regarding the use of duplex, quadruplex and octoplex sets. Out of 35,000 offices in the United States, he did not think there were 3,000 multiplex machines in use. Because of their complexity, it would be hard for them to break in upon the ordinary work, and he thought that for a long while, throughout the length and breadth of the land, the Morse system would prevail.

In closing the discussion of the evening, Sir William told some of his early experiences. He began his work in 1852, and had had fifty-five years' practical experience in telegraphy. One of the prides of his life was that he had had something to do with every advance which had been made in the art. In 1853 he had worked with Faraday and George Wren. That a time when static disturbances gave a great deal of trouble, and they knew

SIR WILLIAM HENRY PREECE, K. C. B., PAST-PRESIDENT INSTITUTION OF ELECTRICAL ENGINEERS, OF GREAT BRITAIN.

very little about them. He told of Edison's making a trip to England early in his career to experiment with an automatic system. Edison was given the use of a thousand miles of cable coiled in the tanks of one of the cable-making companies. Before proceeding with a certain test Mr. Edison had asked him how long he thought the dot would come out. Sir William had in mind a cable line stretched out a thousand miles. He said, "Oh,

SAMUEL SHELDON, PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

about six inches." "Now, gentlemen," said Sir William, "I want you to know how long that dot was. Edison said, 'But think of a cable coiled up in the tank. How long do you think that dot will be?' I said, 'Oh, I don't know.'" Then raising his hands and speaking very solemnly, Sir William said, "Gentlemen, that dot came out just twenty-eight feet long!"

The question of high-speed working on telegraphic lines Sir William thought was a matter of the business which the companies had to handle. The Wheatstone system had been developed up to a point where it could work faster than business could be received. There was no need of automatic systems which would work faster than they could be supplied. He thought that in England the newspapers used the telegraph systems to a greater extent than they did in the United States, but the Wheatstone system was able to handle all the business which was brought to the telegraph offices.

Sir William took occasion to speak of the very happy conditions under which he had always visited the United States. He had always been treated with the greatest hospitality. It was not so much the hospitality as the way in which it was advanced. He hoped that he would be spared to come back and worry us very frequently.

The meeting was then adjourned.

TUESDAY, APRIL 16.

At 3 P. M., Tuesday, April 16, the formal dedication ceremonies were held in the auditorium of the building. The Richard Arnold double sextette opened the exercises by the rendition of Handel's *Largo*.

Charles Wallace Hunt, past-president of the American Society of Mechanical Engineers, was the presiding officer, using as a token of his office the ivory setting maul which was employed by Mrs. Carnegie in laying the cornerstone of the building. Mr. Hunt announced that this gavel would be used by the presiding officers in conducting the meetings held in the building.

The Rev. Edward Everett Hale, chaplain of the United States Senate, invoked the Divine blessing, following which communications were read from the President of the United States, the President of the Republic of Mexico, the Governor-General of Canada and the oldest living mechanical engineer, Charles Edward Haswell.

The message from President Roosevelt was read by T. C. Martin, as follows:

"I heartily congratulate you on the opening of the building of the engineering societies. The building will be the largest engineering centre of its kind in the world. It is, indeed, the first of its kind, and its erection in New York serves to mark and emphasize the supremacy which this country is steadily achieving through her proficiency in applied science. The whole country is interested in the

erection of such a building, and, particularly, of course, all those who follow either the profession of engineering or any kindred profession; and in no branch of work have Americans shown to greater advantage what we like to think of as typical American characteristics. With all good wishes, believe me, sincerely yours, Theodore Roosevelt."

The good wishes of President Porfirio Diaz, of Mexico, were expressed through his ambassador, Enrique Creel.

Earl Grey, Governor-General of the Dominion of Canada, telegraphed that he had expected to be at the meeting, but that his train was delayed and he would arrive as soon as possible.

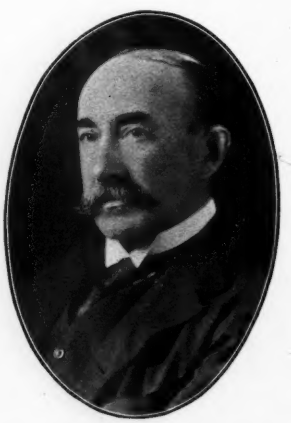
Charles F. Scott, chairman of the conference committee of the United Engineering Society, in a historical address, pointed out some of the features connected with the creation and development of the enterprise. He sketched briefly the interest of Mr. Carnegie in the work, and paid a tribute to his generosity and magnanimity. Mr. Scott said that engineering and the work of the engineers underlie, in a most substantial manner, the whole fabric of industrial and economic conditions. Emphasizing the necessity and utility of such a building, Mr. Scott stated that since the project was first taken up four years ago, the aggregate membership of the societies interested had increased over fifty-three per cent. Years ago there was a spirit of secrecy among the engineers, and during this time stagnation prevailed. When, however, open discussion of problems came about, progress began to be made. The purpose of the building, first of all, is to perpetuate cooperation among engineers. Mr. Carnegie had planned to give the engineers "a union building for you all." The harmonizing influence of this gift would undoubtedly prove a stimulus to further action and make the engineers worthy of the gift.

Following Mr. Scott's address, the keys of the building were turned over by Architect Herbert D. Hale to Chairman Hunt, who, in turn, presented them to E. E. Olcott, president of the United Engineering Society. Mr. Olcott, in a brief address, accepted the building for the United Engineering Society, representing the founder societies.

Chairman Hunt then introduced Andrew Carnegie, the donor of the building. The large audience rose *en masse* and cheered for some time. Mr. Carnegie, very much affected, tried to stop the applause, first by facing the audience and raising his hands, and then by turning his back upon it. He finally said, "Don't cheer too long; you may not be able to hear what I have to say." Mr. Carnegie quoted an old Scotch saying: "Fools and bairns should never see a thing half done." He did not wish to put himself either in the class of the fool or the bairn, but he did think that donors should never see

FREDERICK REMSEN HUTTON, PRESIDENT AND PAST-SECRETARY, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

a thing half done; consequently, he had gone to Pittsburg last week and had taken part in the dedication exercises of the most beautiful palaces of learning. This occasion was the first time that he had seen these palaces in Pittsburg. His experience with the Engineering Societies Building was similar, as this was the first time that he had been within its doors.



JOHN HAYS HAMMOND, PRESIDENT AMERICAN INSTITUTE OF MINING ENGINEERS.

He thought that everything was very beautiful; that the architects and the engineers had wrought an exquisite piece of work. He did not take any credit to himself for what he had done, but he did believe that the men who had brought about the erection of the building, the men who had created the spirit of enterprise which resulted in such a temple to science, were worthy of emulation. Wherever men work together for benevolent purposes it raises them beyond the plane which any selfish interest can. When men do some good for somebody, unification takes place. When men conspire against each other or against their governments, they can not trust each other; consequently, disintegration and disaster follow. He was satisfied that good men need not lie awake worrying about the future of the country. Just as surely as the sunflower turns its face toward the sun, so surely does the human race march onward and upward toward the sun. Many things that he had learned had been forgotten, and much had passed away; but there was one thing upon which he rested and in which he found happiness. This was the thought that all is well as long as efforts for the common good are being made. To-day is better than yesterday, and to-morrow will be better than to-day. This is the way that progress is made. The nearer men come to a common brotherhood, the nearer will they attain to a common happiness. This thought was to him very comforting, and was the one upon which he settled his mind in peace and happiness.

Mr. Carnegie then expressed his gratification at the way in which the architects were chosen. In the open competition the plans of two comparatively obscure architects had been selected by the conference committee. It was peculiar that one of the architects was a son of the Rev. Dr. Hale, and the other a brother-in-law of Mrs. Carnegie. Mr. Carnegie made a witty sally upon each of the persons involved, producing quite a laugh at their expense. He said that there was considerable cause for satisfaction in the way the plans had been carried out. There was always so much opportunity for mistakes. Even Homer nods, and of all classes he thought the architects nodded the most often.

Speaking of the altruistic principles of the engineer, Mr. Carnegie said that the engineer worked along true lines. Two plus two made four, and adding one we got five. This was the way the engineer worked—no fraud, no deviation, no falling out of step, but march, march, march straight away along lines of progress.

The great advantage that Americans had, he thought, over other nations of the earth was that they combined the good features of all the other nations. Their ability to agree among themselves was in

itself the greatest and most potent element for success. An example of this ability to agree was evidenced in the harmony with which the committees had performed their work. You could not expect Britons to do this, and, indeed, the Scotch never would. It reminded him of an old Scotchman, who said, "Sandy, are ye coming down to the club?" He was asked, "What are you going down there for?" He said, "Oh, just to contradict a wee." In America a spirit of democracy prevailed. One man was as good as another. Nowhere was the old axiom witnessed with such truth as in this land. This axiom was his guiding inspiration: "We only hate those we do not know." And, said Mr. Carnegie, we only have to know the virtues of our fellow men to find out they are all right, and we can only be great as we realize—as the engineers of America have apparently realized—that "all men of all nations are brothers."

Following Mr. Carnegie's address, Schumann's dream song, *Traumerei*, was rendered.

The closing event of this day's exercises was an oration by Arthur Twining Hadley, president of Yale University, on "The Professional Ideals of the Twentieth Century." Dr. Hadley's principal thought was that the engineering profession had in it the ability first to find out, then to create, and then to erect. No set of men were so capable of directing public affairs. It was fitting that, following so soon after the close of the nineteenth century, which was truly an engineering era, that this temple should have been erected as a headquarters for engineers. He thought that, in spite of the wonderful strides that had been made in engineering, that great work still remained to be done. If the engineers were true to their principles they would always be the most vitally interested and the most vitally important set of men connected with the affairs of the world in general.

In the evening, from 9 to 10.30 o'clock, a general reception was held in the main auditorium. At 10 o'clock the officers and councils of the founder societies received their guests in their respective headquarters.

WEDNESDAY, APRIL 17.

The dedicatory exercises were continued at 2.30 P. M., Wednesday, April 17. The introductory address was made by John W. Lieb, Jr., chairman of the dedication committee.

Addresses were then delivered by Samuel Sheldon, president of the American Institute of Electrical Engineers; F. R. Hutton, president of the American Society of Mechanical Engineers; John Hayes Hammond, president of the American Institute of Mining Engineers, and T. C. Martin, president of the Engineers' Club.

Following these addresses, greetings and felicitations were read from the foreign and national scientific societies and institutions of learning.

RALPH W. POPE, SECRETARY AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

James Douglas, past-president of the American Institute of Mining Engineers, had been called to England because of the death of his daughter, and was unable to deliver his address.

Charles F. Scott, chairman of the John Fritz medal board of award, and past-president of the American Institute of Electrical Engineers, presented the John Fritz gold medal to Alexander Graham Bell.

ROSSITER W. RAYMOND, SECRETARY AMERICAN INSTITUTE OF MINING ENGINEERS.

This ceremony was followed by the presentation of commemorative medals for distinguished services to the secretaries of the founder societies, a ceremony in which considerable interest has been taken, by virtue of the peculiar record of services to the various societies of the recipients of these medals, which were presented to R. W. Pope, secretary of the American Institute of Electrical Engineers; F. R. Hutton, past-secretary of the American Society of Mechanical Engineers, and Rossiter W. Raymond, secretary of the American Institute of Mining Engineers. The presentations were made by A. R. Ledoux, past-president of the American Institute of Mining Engineers, representing the three societies.

On Thursday, April 18, the American Institute of Mining Engineers held a meeting at 2 P. M. An illustrated paper by H. T. Hildage, entitled "Mining Engineering Operations in New York City and Vicinity," was read. This paper was descriptive of the excavation and tunnel work in connection with the Pennsylvania Railroad now in progress in Greater New York.

At 8 P. M., Thursday, the American Society of Mechanical Engineers held a meeting in the main auditorium, when a paper was presented by Brigadier-General W. Crozier, U. S. A., on "The Ordnance Department as an Engineering Organization."

On Friday, April 19, at 8 P. M., an informal smoker and vaudeville was held in the Madison Square concert hall, under the management of the American Institute of Mining Engineers, for the members of the three founder societies.

Power Plant Contract for Congressional Buildings Awarded.

The United States Government has awarded to the Westinghouse companies a contract for the complete electrical equipment of the power station now being erected in connection with the new Congressional buildings in Washington, D. C. It will be a modern plant, located about four blocks south of the Capitol in Garfield Park, and will, when finished, furnish heat, light and power for the group of buildings immediately surrounding the Capitol, namely, the Congressional Library, the new Senate and House Office buildings, and the Capitol itself. The contract calls for four 3,000-horse-power Westinghouse-Parsons steam turbines and four 3,000-horse-power Westinghouse generators. The machinery will all have to be delivered before the end of the present year, when the plant is expected to be in full operation. All of the apparatus is now being constructed at the East Pittsburg works.

Death of General Eugene Griffin.

General Eugene Griffin, first vice-president of the General Electric Company, Schenectady, N. Y., died, shortly after one o'clock on the morning of April 11, at his apartments in the Mohawk Club in that city. His death resulted from apoplexy. With his wife and daughter, he had come to Schenectady to witness an amateur play given by a local club, of which his son, Hancock Griffin, was a leading member. Following the performance, while at an informal supper with a few friends, the general collapsed, expiring about an hour later.

This sudden death of General Griffin removes from the electrical world, as well as from military and social circles, a man of broad and keen intellectual interests.

General Griffin was born in Ellsworth, Me., on October 13, 1855, and was graduated from West Point in the class of 1875, immediately becoming a second lieutenant in the Engineer Corps of the regular army. In the fourteen years which followed he rose to the rank of captain of the corps. In 1889 he resigned from the army to take up electrical engineering work.

Upon leaving the army, Captain Griffin entered the service of the Thomson-Houston Electric Company as second vice-president. This position he held until 1891, when the Thomson-Houston company was consolidated with the General Electric Company. He was then elected to the office of first vice-president of the General Electric Company. In 1893 he was elected to the position of president of the Thomson-Houston International Electric Company. He was also a director of the British Electric Company, and the Campagnie Francais pour l'Exploitation de Procedes Thomson-Houston, Paris.

At the outbreak of the Spanish-American war, Captain Griffin offered his services to the United States Government. On word from Washington, he organized the First Regiment United States Volunteer Engineers, of which he became colonel. This regiment was mustered into service in the spring of 1898. The following year, in January, he was promoted to the rank of brigadier-general. This title he held at the close of the war.

General Griffin was prominent in club life, being a member of the Union, Racquet and Tennis, University, Engineers, Ardsley Riding, and City Midday clubs, of New York city. He was also a member of the Metropolitan, at Washington, the Somerset, at Boston, and the Mohawk and Mohawk Golf clubs, of Schenectady, and the City Liberal Club, of London.

In engineering and army clubs, General Griffin held membership in the following: Military Order of Foreign Wars, United States Military Academy Alumni; New England Society, Society of Naval Architects and Marine Engineers, Order of Spanish-American War Veterans; the Pilgrims of the United States; the Institution of Civil Engineering, Great Britain; the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers.

The funeral services of General Griffin were read at the Church of Transfiguration, in New York city, a brief service having been held at the Mohawk Club, in Schenectady, on April 12. The final portion of the burial services were conducted by Dr. Goodwin, who officiated at the wedding twenty-eight years ago. After the services at the church the body was taken to West Point, where interment was made with full military honors. Colonel Scott, the present superintendent of the post, was a classmate of General Griffin's, and a full corps of cadets acted as an escort at the burial. All flags at West Point were half-masted. As the procession left the chapel, eleven minute guns were fired, and after the salute at the grave a second salute of eleven guns was given, followed by taps.

General Eugene Griffin.

The pall bearers were: C. A. Coffin, president, General Electric Company; Colonel H. L. Scott, superintendent, West Point Military Academy; Hinsdill Parsons, Schenectady; B. E. Sunny, Chicago; Colonel H. F. Hodges, major of engineers, Washington; H. R. Bishop, of New York; S. M. Hamill, Schenectady, and Dr. Louis Seaman, of New York.

General Griffin was married in 1879 to Miss Allie Hancock, niece of General Winfield Scott Hancock. He is survived by his widow and two children, Priscilla Griffin and Hancock Griffin.

Datum, Sing.; Data, Pl.—A Hint for Proofreaders.

To the Editor of the Electrical Review:

For several years, during which the writer held a position on the editorial staff of an engineering periodical and it was part of his duty to revise the manuscripts offered by engineers for publication, he was impressed with the fact that the grammatical error most commonly made by engineering writers was the use of a singular verb with the plural noun, "data." Such expressions as "this data," "much data," "little data," instead of "these data," "many data," "few data," were also quite common.

The use of "data is" has become so common lately in technical papers, and even in books written by engineers, that it is apparent that proofreaders as well as engineers need some elementary instruction in the proper use of the language and especially in regard to the plural form of nouns taken directly from Latin and Greek, such as datum and phenomenon. The expressions "memoranda is," "phenomena is," "strata is," are sometimes seen in print in journals which otherwise generally use good English.

I enclose a list of authorities on "data," which shows that all the dictionaries give the word as the plural of datum. It may be said that no good writer ever uses the expression "data is," and no good proofreader ever passes it. Also enclosed is a list of some words taken into our language directly from the Latin and Greek with their singular and plural forms.

William Kent,
Dean of College of Applied Science,
Syracuse University.

Syracuse, N. Y., April 12.

The following lists are those referred to in Dean Kent's letter:

List of Authorities on "Data."

Datum (Pl., data).

"The historical and scientific data on which the solution . . . depends."—Bryce American Commonwealth III., XXVI, 9 (1888).

Data (Pl. of datum). (New English Dictionary, Murray.)

Datum, n. (Pl., data).

1. A fact given. . . . 2. A premise.

"Many philosophers have attempted to

establish on the principles of common sense propositions which are not original data of consciousness . . . these data the same philosophers were (strange to say) not disposed to admit."—Sir W. Hamilton.

Data, n. (Pl. of datum). (Century Dictionary.)

Datum, n. (Pl., data). 1. Something given or admitted.

"Any writer, therefore, who furnishes us with data sufficient to determine the time in which he wrote."—Priestly.

Data, n., Pl. (L., *data*, given.) Things given or admitted, quantities, principles, or facts given, known, or admitted, by which to find things or results unknown. (Webster.)

Datum, n. (Pl., data). Something assumed or known.

"Every science has its data; fundamental principles assumed to be true."—J. Harris, "Great Teacher," Essay, I, i, p. 66.

Data, n. (Pl. of datum).

Data of consciousness. 1. Internal or spiritual facts immediately perceived by consciousness. 2. Truths known by intuition. (Standard.)

"Unhappily the data for this Shelley we had and knew long ago, while the data for the unattractive Shelley are fresh."—M. Arnold, Essay on Shelley, p. 244 (1888).

LIST OF WORDS TAKEN DIRECTLY INTO THE ENGLISH LANGUAGE FROM THE LATIN OR GREEK.

Singular	*Plural*
datum	data
focus	foci
genus	genera
nebula	nebulæ
phenomenon	phenomena
alumnus	alumni
alumna	alumnæ
larva	larvæ
stratum	strata
terminus	termini
fungus	fungi
effluvium	effluvia
vertebra	vertebræ
erratum	errata
cactus	cacti
radius	radii
medium	media
memorandum	memoranda
automaton	automata
formula	formulæ
bacterium	bacteria
curriculum	curricula
criterion	criteria
stadium	stadia

Important Change in the Manner of Purchasing Supplies and Material for United States Naval Service.

E. B. Rogers, Paymaster-General, U. S. N., has issued the following general notice:

"1. An important change in the manner of purchasing supplies and materials for the naval service is authorized by the act of Congress approved March 2, 1907, by which it will be unnecessary hereafter for a bidder to execute the formal guarantee, and formal contract and bond, on proposals which do not exceed $500, on any one class contained in any one opening.

"2. On bids under $500 the 'conditions' on the second page of the proposal form ('Form A') need only be signed by the bidder in the manner prescribed in the footnote. The accepted bid will be covered, as soon as the award is determined, by a 'bureau order' authorizing the bidder to proceed at once with deliveries, and stating terms under which the award is made.

"3. The bureau will, in the near future, establish a mailing list, and will place your name thereon, in order that you may receive advance information of purchases to be made after formal advertisement, the bids for which will be opened in this bureau. This weekly 'notice of purchases' will be alphabetically arranged, giving the names of the articles to be purchased, the quantity, place of delivery, and the date of the opening of bids. Bidders may, therefore, keep in constant touch with the bureau's requirements in their lines and make applications for schedules covering articles on which they desire to bid. Application cards will be furnished each bidder; and, as soon as the 'notice of purchases' is received, the application, stating merely the number of the schedule or schedules desired, should be forwarded at once to this bureau. Applications will be filled as soon as the schedules are received from the public printer. Schedules can also be obtained upon application to the navy pay offices located in the various cities where the material advertised is to be delivered.

"4. Another important change will be made in the method of accepting deliveries at navy yards. Heretofore it has been necessary for the bidder to unload the material from the cars when delivered at the navy yard; but formal proposal ('Form A') will be so amended as to provide that in case of shipments by rail the material will be unloaded from the cars at the expense of the government. The introduction of a system of f.o.b. cars or f.o.b. wharf will, it is believed, be most favorably accepted by all bidders. Other changes are under consideration, such as expediting payments to contractors, etc.

"5. In this connection your attention is invited to the fact that if you have not already an annual guarantee on file in the bureau, you will be saved the inconvenience of preparing an individual guarantee on each bid in excess of $500, by executing on blanks furnished by the bureau, an annual guarantee, which will be accepted in lieu of the separate guarantee on all proposals which you may submit during the fiscal year for which given. The annual guarantee may be executed by any one of the well-known surety companies, or by two individuals, if preferred.

"6. The bureau will not publish, in printed form, the results of each opening of bids. This information may be obtained from the *Government Advertiser*, issued from the Bond Building, Washington, D. C., which is the only paper, of which this bureau is aware, that publishes this information.

"7. When time will permit of advertising, an advertisement, giving a list of the articles required, is inserted in one of the leading daily papers of the port nearest the navy yard at which the supplies are to be delivered once a week for two weeks previous to the time when the bids are to be received in this bureau for the supplies in question. When time will not permit of advertising, purchases will be made in the open market through the navy pay offices located at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York (280 Broadway), N. Y.; Philadelphia (Post-Office Building), Pa.; Baltimore (Custom-House), Md.; Washington (Mills Building), D. C.; Norfolk, Va.; San Francisco, Cal., and Seattle, Wash."

The following schedule of electrical goods required has been announced, for which bids will be opened in Washington, D. C., April 30:

ELECTRICAL MATERIAL.

Article.	Quantity.	Delivery at Navy Yard.	Schedule.
Cable, lead covered	12,000 feet	Washington, D. C.	613
Cable, copper, rubber covered	1,600 feet	New York, N. Y.	617
Cable, submarine	3,000 feet	Washington, D. C.	618
Conduit, enameled	1,350 feet	Boston, Mass.	613
Electroliers, etc	Miscellaneous	Boston, Mass.	613
Equipments, ammunition hoist	16	Various places	618
Equipments, gun elevating	16	Various places	618
Equipments, breech opening	16	Various places	618
Equipments, rammer	16	Various places	618
Insulating tape	200 pounds	League Island, Pa.	633
Switch boxes	3	Boston, Mass.	613
Wire, copper	5,000 feet	Boston, Mass.	613
Wire, copper	14 miles	Washington, D. C.	618
Wire, lighting	2,500 feet	Norfolk, Va.	625

National Electric Light Association.

It is announced that about two-thirds of the exhibition sections in the large ballroom of the New Willard Hotel, Washington, D. C., have already been taken by associate members of the National Electric Light Association for exhibition purposes in connection with the convention to be held June 4, 5, 6 and 7. The committee in charge of these preparations is considering an unusually attractive display of electrical decorations, which will greatly add to the attractiveness of the exhibition as a whole.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Modifications of the Maxwell-Rayleigh and the Anderson Methods for the Measurement of the Coefficient of Self-Induction.

The Maxwell-Rayleigh method for the measurement of the coefficient of self-induction is theoretically more free from doubtful corrections than any other method. It has been discarded, however, on account of an experimental difficulty. The form in which the method was left by Lord Rayleigh necessitates, in addition to balancing the Wheatstone bridge and the ballistic galvanometer, a deflection of the galvanometer produced by the continuous current when one arm of the bridge has been overbalanced by a very small unknown amount. After the introduction of this small resistance, and during the interval required for the deflecting needle or coil to come to rest, the resistance of the copper inductance coil is changed by heating due to the current and by variations in the temperature of the room, so that when the galvanometer reading is observed, a deflecting current is produced by an overbalancing resistance which differs from the small known resistance introduced. The amount of change in the resistance of the copper coil is unknown, but is usually sufficient to render results uncertain within one per cent. A. Zeleny here describes a method which renders the objectionable measurement unnecessary and makes the method accurate. This consists merely in omitting the measurement with a small known resistance for disturbing the balance in the Wheatstone bridge, and substituting for it the measurement of the current in the main circuit. The modified method presents for work of precision an advantage over all other known methods, on account of a greater freedom from uncertain corrections. This modification also enables a comparison of inductances to be made with ease. In Anderson's method as now employed, a condenser is connected permanently in the circuit, so that after a balance is obtained and the circuit is opened, the liberated absorbed charge as well as the free charge of the condenser affect the galvanometer. For this reason the results obtained are dependent upon the period of the galvanometer and upon the resistance in the condenser circuit, and may be in error by more than one per cent, even when a good condenser is employed. No accurate determinations can be made in this way unless the effective capacity of the condenser or the particular apparatus is first obtained, but this is not practicable. The capacity value of standard condensers are usually determined by an intermittent current giving 100 interruptions per second. This should give the free charge capacity values of good condensers with sufficient accuracy for all ordinary purposes. The author modifies the Anderson method so as to render only the free charge of the condenser effective, and this method has been shown experimentally to be capable of as high a degree of accuracy as the modified Maxwell-Rayleigh method. It possesses a slight disadvantage theoretically, as it is less sensitive and requires a double balancer, but it has the advantage of being a zero method and of not requiring the measurement of several electrical quantities necessary in the employment of the other method.—*Abstracted from the Physical Review (Lancaster), March.*

The Properties and Industrial Applications of the Electric Arc Produced by Means of Electrodes Consisting of a Mixture of Carbon and Mineral Substances.

An interesting review is given here by A. Blondel of the development of the so-called luminous arc lamp. The idea of improving the luminous efficiency of the arc seems to have resulted from the work of Nernst and Auer, who showed that the efficiency of a lamp is not simply a question of temperature. Nernst and Rasch endeavored to improve the lamp by using other materials for the electrodes instead of carbon, but the fact that most of these materials suitable for giving a large amount of light were not conductors when cold led to the addition of other materials in order to give the necessary conductivity. Carbon and other conducting substances were added. In 1898 Bremer took up the work. He was not specially trained in the electrical arts, and was ignorant of what had been done. He therefore started out without any prejudices, and after long, tedious and discouraging work, he finally produced the first successful luminous arc lamp, which was exhibited in Paris in 1900. His work consisted in adding materials to the carbon so as to increase the luminous efficiency, and in changing the arrangement of the lamp so that the slag formed would not interfere with its operation. The two electrodes were placed nearly parallel, the arc being struck between their lower ends and blown outward by a magnetic field. A great deal of work has been done to determine the best materials and proportions to be added to the carbon for these electrodes. Casselman, in 1884, added borates and sulphates or boric acid to carbon; Ortley added silicates; Lacombe, in 1890, sulphates, chlorides, phosphates; Mignon and Rouart gave the electrodes a vitreous coating; Julian added silicates, tungstates and the salts of calcium magnesium, potassium and sodium. These materials were used in order to reduce the combustion of the carbon. To increase its conductibility, Carré added borates of sodium, potassium, magnesium and calcium to the carbon before baking. Feussner used boric acid and compositions of the alkaline earths. To prevent the formation of slag Carré added potassium and sodium. This also had the effect of giving a steady arc. Bremer pointed out the advantage of a large proportion of salts of calcium and magnesium, as the slag formed by these is easier got rid of. To increase the amount of light, Gauduin, in 1878, added calcium, notably in the form of a phosphate and in proportions from six to ten per cent. This doubled the amount of light obtained for a given carbon. He showed also that good results were obtained by the use of oxides, chlorides, silicates and aluminates of calcium and sodium. Pure magnesia gives good results, but not quite as effective as the other salts mentioned. Jablochkoff used clay and kaolin. In 1878 Rapief brought out a lamp using impregnated carbons placed at an angle to one another. Many of the patents on these lamps cover the use of certain salts in certain proportions, usually less than ten per cent, and sometimes as high as twenty. The author then gives a review of his own work in this direction. His object was to produce a lamp having vertical electrodes, in order to obtain a certain character of distribution. He first attempted to secure uniformity of consumption of carbons by causing the

arc to rotate. This was abandoned and the arc maintained centrally by constructing the carbons of several layers. The inner, or core, may be pure carbon or slightly impregnated. This is surrounded by a tube of impregnated material which furnishes the luminous vapor, and this, in turn, is surrounded by another layer containing salts which act as fluxes and prevent the slag from collecting on the top of the lower electrode. The upper carbon is surrounded by a condenser to prevent smoke. This is thought to economize the carbons somewhat, because it prevents a rapid circulation of air.—*Translated and abstracted from L'Éclairage Électrique (Paris), March 16.*

The Electrification of Steam Railways from the Operating Point of View.

A discussion of the relative disadvantages of the third-rail and overhead systems of electric traction is given here by a railway engineer, who makes a comparison decidedly to the disadvantage of the latter system. It has generally been realized that a three-phase system is not suitable for electric traction except for lines with few junctions and where the complications involved by the overhead system are comparatively small, but it has not been generally realized that any system involving overhead wires is unsuitable on a railway with large traffic and many sidings, junctions, bridges and cuttings. The denser the traffic, both actual and prospective, the better the financial results that may be expected by the change from steam to electric haulage, but the system of transmitting power to the train must be one which may be installed and maintained with least interference to train movement. The design of an overhead system for an existing line offers difficulties which can best be realized by actual inspection. Chief among these is the location of the supports for the overhead work. Usually the space between tracks is not sufficient to permit of the erection of any pole there, still less for a support of the lattice-girder type. In some cases the construction of lines is modified so as to allow of a wider space between tracks, but where this has been done the space is occupied already by signal posts, telephone and telegraph lines, and other necessary railway equipment. It follows that, in laying out the overhead construction, not only will special work be involved wherever sidings appear along the side of the main line and extensive work done in slewing the sidings to find room for the support of the network, but also extensive alterations to existing wires, signal posts and boxes will probably be involved. On the other hand, the laying of a third rail involves no special work of any kind, except a little bending of rail, which can be done by the track men, and also some cable laying of a very simple description. The erection of the overhead lines also offers great difficulties, and would, in many cases, have to be done entirely at night and on Sundays, adding to the cost already incurred by the extensive special work required. Respecting the cost of equipment, the cost of transformers and feeders, assuming proper sectioning on the overhead system, would be the same in both cases. There would be a monthly surplus on the third-rail system sufficient to provide an open main line about 300 kilowatts of rotary-converter power per mile of double track, a sufficient allowance for a straightforward main line with a fairly dense traffic. For such work the two systems are almost on a footing, but when the work in and in the vicinity of towns and siding work is considered, the cost per mile will remain the same. The greatest difficulties occur in the operation. A single-phase system is supposed to have two principal advantages as compared with the third-rail system: First, the working conductor is inaccessible to the public, and consequently safe; secondly, the high voltage that may be employed makes it unnecessary to have any substations in case of short lines, and in case of long lines the substations can be fairly widely spaced, and do not require attendants permanently on duty. The first advantage is really a slight one, as a track is never a safe place for the public, and the presence or absence of a third rail affects it but little. As regards railway employés, practically no accidents have occurred to them due to the presence of the third rail, and all ordinary railway operations are carried on without any special difficulty. Any accident to the overhead conductor is much more difficult to deal with than an accident to a third rail. The most likely sources of accident on an overhead network will be defective insulators, broken wires or disturbances to supporting poles. In any case the work of repair is likely to be tedious. On the other hand, a damaged third-rail insulator may melt completely without interfering with traffic, and any laborer can remove it, if necessary, by a blow of a hammer. On railways reliability of service is of prime importance, and on a line of any magnitude any defect in a section must be promptly dealt with, a single-line working, if necessary, being put into operation. For this reason it will be necessary to section the overhead wires in such a way as to make it easy to cut the current off any section for either the up or the down track. It is most difficult to design section switches suitable for unskilled operation, for the high voltages now contemplated for the single-phase system. Contrariwise, the section switches on a third-rail system are of the simplest description and require in practice infrequent inspection and no repairs. A more difficult matter is to make provision for the prompt replacement of feeder circuit-breakers after temporary short-circuits. Inspection and repairs of overhead trolley line will offer difficulties unknown on a straight railway system. It has been necessary for such repairs to be done from something like a tower wagon propelled by power, and it will preclude all inspection except at night. Reliability of service is of more importance to a railway than two or three, or even fifteen, per cent initial cost. A breakdown on an interurban system is of less importance than a ten-minute delay on an important main line. Such difficulties as have been outlined will, no doubt, be overcome at a cost, but there seem to be difficulties graver and less easy of solution than those which present themselves to the designers of pioneer third-rail systems. A third-rail system will succeed best on suburban lines, and the probability is that it will prove best for the British main lines also, should they be electrified.—*Abstracted from the Electrician (London), March 29.*

The Convention of the National Electrical Contractors' Association.

The seventh annual convention of the National Electrical Contractors' Association will be held in New York city, July 17, 18 and 19. The indications point to the convention being one of the most largely attended and most interesting in the history of the association. The committee in charge consists of J. C. Hatzel, chairman, 571 Fifth avenue, New York city; F. J. Miner, 207 Jefferson avenue, Detroit, Mich., and W. I. Patterson, 218 Ferguson Building, Pittsburg, Pa.

Fire Loss for the Interborough Rapid Transit Company.

On Monday, April 8, the car-barns and substation of the Interborough Rapid Transit Company at Lenox avenue and One Hundred and Forty-sixth street, New York city, were destroyed by fire, the loss being estimated at $1,500,000. Most of this is for the destruction of 300 cars, which cost, on an average, $3,800 apiece.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

Power "Ads" in Newspapers.

No matter how good an advertisement may be, if it falls into the wrong hands it will fail in its purpose.

Yet, how often you have seen power "ads" occupying considerable space in newspapers!

It's a hundred to one shot that the man who inserted them never stopped to figure out whether or not such "ads" were of much use or benefit to his central station.

What would you think of a big manufacturing firm in New York city using all the daily papers in the country to advertise a certain proposition to the hardware dealers of the country? The advertisement might answer the purpose to a certain extent—but the expense would give the billion-dollar steel trust "palpitation."

Now, honestly, you don't often see the captains of industry in other lines indulging in such an unwholesome and foolhardy exhibition of advertising. Do you?

Nevertheless, when you see a power "ad" in a daily or weekly newspaper, you must recognize just such a colossal exhibition of waste, extravagance and lack of judgment as was shown by that hypothetical manufacturer in New York city. You are buying circulation when you are buying newspaper space—remember that. And when you want to reach a few prospective power users there is no occasion to buy several thousand circulation to reach perhaps about five hundred power users, for the waste circulation is of no earthly use in furthering the power end of your business.

So, to insure your advertising reaching the persons intended in a campaign exploiting electric power, the proper selection of a medium is very essential.

In the opinion of careful and experienced central station managers, the medium of direct-by-mail advertising is the only feasible, sure and economical method open to central stations to reach prospective users of electric power.

Direct solicitation is, of course, another means, but the solicitor has a mighty hard job before him if the prospective customer has never before been interested in electric power by means of advertising.

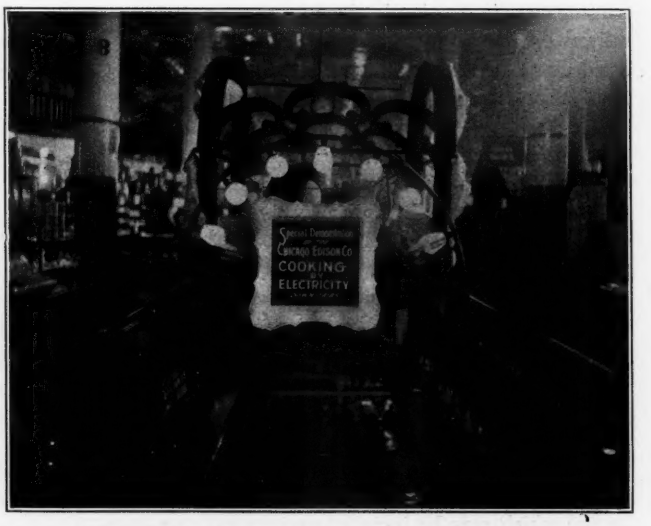
A good series of direct-by-mail advertising, if well illustrated, and strongly, interestingly and economically written, arouses the interest of the receiver at once, and holds it to the end. You can present the manifold advantages of electric power in such a manner as to create a desire for the improved conditions.

This could never be done by newspaper advertising, as lack of space prevents your telling the whole story. And, as a general rule, business men do not read advertisements in the daily paper as do women.

But direct-by-mail advertising comes to him with a proposition to improve his business just when he is most interested in his business—when opening his mail, and it is bound to receive careful attention.

Newspaper advertising may be all right for advertising electricity for light and domestic purposes, but to try to interest power users in the electric motor through the medium of the daily press shows that sufficient thought has not been given to the matter.

Electrical cooking demonstration recently held by the Chicago Edison Company in Siegel-Cooper Company's store, where numerous articles of food, such as cakes, biscuits, bread, lobster á la Newburg, etc., were prepared. This demonstration attracted widespread attention. Samples of the various dishes were distributed. The result was a number of sales of electrical cooking apparatus.



This sign was installed by the Chicago Edison Company at the time it was holding its electrical cooking demonstration in Siegel-Cooper Company's store, to attract the people to the basement, where the demonstration was held.

What One of the Large Central Stations Is Doing.

In a week or so we expect to publish in this department a complete, exhaustive and interesting account and description of the advertising being done by one of the largest central stations in America—the Edison Illuminating Company of Brooklyn, N. Y.

This company has the reputation of being one of the most energetic electrical central stations in the United States, and its advertising is some of the best and

most successful gotten out by any company of its kind. It will certainly pay all central station managers to look for this article, and see that it receives their careful perusal.

While we know that conditions are somewhat different with smaller central stations, yet if such advertising brings large returns in these largest cities, where the people are constantly besieged with literature of all kinds, it is bound to bring even greater returns in smaller cities and towns where people have more time and, as a general rule, receive less printed matter.

So don't read this article, let it pass out of your thoughts and "lie down" just because you do not happen to be located in Brooklyn, or any of the other large cities.

Under this general heading we shall present to our readers a series of bright, stimulating talks to solicitors, which, we believe, will prove valuable to managers of new-business departments in suggesting points which they can profitably bring out in their occasional meetings with the company's representatives.

We shall gratefully accept contributions and suggestions from any of our readers.

A young salesman was once called upon unexpectedly to address a Sunday-school. In order to gain time and collect his scattered senses he inquired:

"Well, children, what would you like to have me talk about?"

One little fellow arose to the occasion and shouted: "Please, mister, talk about one minute."

Now, that's about how much time I've got to talk to you fellows this morning. So I'll jump right in by asking what's the matter with you all, anyway? Lost your ginger, or what? Nothing doing all week. Not a blessed contract landed. Of course, you may all think you have become inoculated with the spring fever germ and feel lazy. But that's no excuse. Spring fever germs or no spring fever germs, we've to get the business to keep the wheels running. How do you expect the company to pay salaries if you don't do your share of the work? So get rid of the spring fever idea at once, fellows. Quit thinking of the opening ball game, etc., and concentrate your mind on your work.

The next thirty or sixty days will give you an opportunity to demonstrate what you're worth to the company. So take advantage of it by getting out and hustling. Right now, before the opening of hot weather, is the time to hit Mr. Power User and Mr. Merchant with the cool, no-heat advantages of electric power and electric light. Show them where electric fans are a good investment, not only adding to the comfort of their employés, but enabling them to do more work.

Then don't forget the cafés, restaurants, ice cream parlors, etc. Hammer these with arguments on the advantage of keeping their places cool to draw the trade. In fact, fellows, all along the line, you'll find limitless arguments you can use in persuading people, in every walk of life, to use electric current.

Now show me the stuff that's in you boys, by getting out and wiping out the record of the past two or three weeks, by turning in a few good contracts. You can do it well enough, if you just make up your mind you can.

Under this heading we shall, from week to week, present to our readers a little series of inspirational aphorisms (original, aboriginal and selected), which will, we believe, prove stimulating and suggestive to those who are interested directly or indirectly in the sale of central station current.

Use judgment in addressing people; no two are alike.

Don't knock; every knock is a boost.

Two heads are better than one—every suggestion is worthy of consideration.

Never try to talk business to a man when he hasn't the time to listen. Call again.

Do what you are asked to do, then make suggestions.

The solicitor finds situations and conditions the office is ignorant of. Look and listen, then inform your manager.

There is less difference in men's ability than in their energy. Energy increases enthusiasm. Energy counts.

Accept everything printed in this little book for whatever your own reason shows it to be worth.

It's easy to collect a bill and offend your customer, getting him "sore" at the company. It's just as easy to collect and make the debtor a firmer friend, if you know how. Learn how.

When entering your customer's place of business don't act as if you owned it. Don't help yourself to the dried apples or out of the cracker box; those edibles are for sale, not to be eaten as samples.

Cultivate a memory for names and faces. You'll probably have to call on the same people two or more times.

When your company tells you to bear certain things in mind, don't forget them. Attend to every detail scrupulously and you'll find your company will appreciate you.

Aim to please—practice hitting the bull's-eye.

Mushroom enthusiasm is valueless for long-continued service.

Buck gas hard, but don't knock.

When you have made a statement, stick to it. Not aggressively nor over-assertively, but in a dignified manner.

Always bear in mind that your prospective customer possesses as much, or more, intelligence than yourself; therefore, never make an impossible statement.

Electric power requires no shafting or belting. It requires no coal. It requires no engineer. It requires no fireman. There are no ashes to be removed. It's *the* power.

Electric heating is the only kind of heating.

Electric cooking is the only kind of cooking.

Find out the why and wherefore; your customers will want to know.

Know enough to talk about what you're selling.

Don't be "scairt out" by a frown; it's habitual with some people. Feel as if you're worth four times what you're getting and hustle accordingly.

Your prospective customer is on the right road, but isn't sure of his direction.

"Good common sense is the best argument; make it a point to steer clear of

intricate statements that your customer won't understand. He will think you are trying to display your knowledge at his expense."

"If a man ain't sure he iz right, the best card he kan play iz a blank one."

If you are not sure of a subject, steer clear of it.

If your customer finds you do not know your subject thoroughly, he will lose faith in you and your goods.

"It takes a great many blows to drive in a nail, but one will clinch it."

Reserve your best argument for the last.

Remember, your company does not expect you to do the impossible.

Never interrupt your prospective customer while he is busy with some one else, or dictating a letter. It's exasperating.

It will be our endeavor, from week to week, to present in this department brief notices of activities among the central stations, as gathered from men who are in the field and, consequently, in close touch with the progress of the new-business idea and its acceptance by central station managers. Contributions to this department are solicited, and will be received with much appreciation by the editor.

If you are doing something a little better than or different from the other fellows, and think it would make interesting reading to ELECTRICAL REVIEW readers, send in your schemes and plans. They will be gladly received.

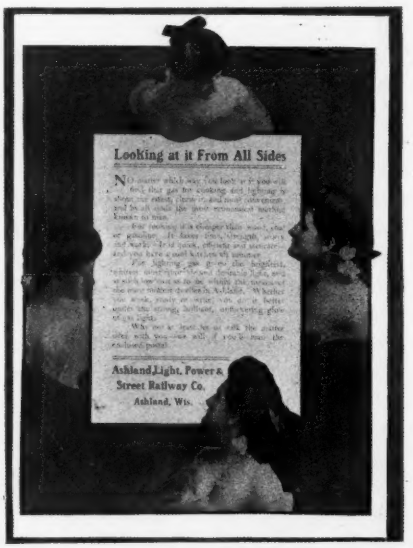
Address all communications to Charles A. Parker, care of the ELECTRICAL REVIEW.

You do not arrive late in the evening in a small city of six or seven thousand inhabitants and expect to be greeted and welcomed very strongly by the glare and glitter of electric lights. That is just exactly why Ludington, Mich., would be considerably a surprise to a good many.

The writer landed there at 10.30 P. M. and expected to find things shrouded in darkness. Instead of that, the main streets were brilliantly lighted, electric signs merrily holding forth, window displays still in evidence, and a general air of metropolitan brilliancy evident on all sides.

Several flaming arcs (which are even yet a novelty on Broadway, New York) were to be seen casting their mellow yellowness on the snow-clad streets, and altogether one was very much inclined to ask if it was some kind of a fête-day in Ludington.

It turned out, however, to be an ordinary Thursday evening in the dead of



A handsome and attractive power folder of the Ashland Light, Power and Street Railway Company, Ashland, Wis.

winter, and an explanation was forthcoming the next day when we called upon the Stearns Light and Power Company and found the reason for all this luminosity.

Here is a folder which was recently mailed by the Stearns Light and Power Company, of Ludington, Mich., which impresses itself on the receiver's mind at a glance. This piece of advertising was printed in three colors, and is one of the plainest and most strongly written that has yet come to our attention.

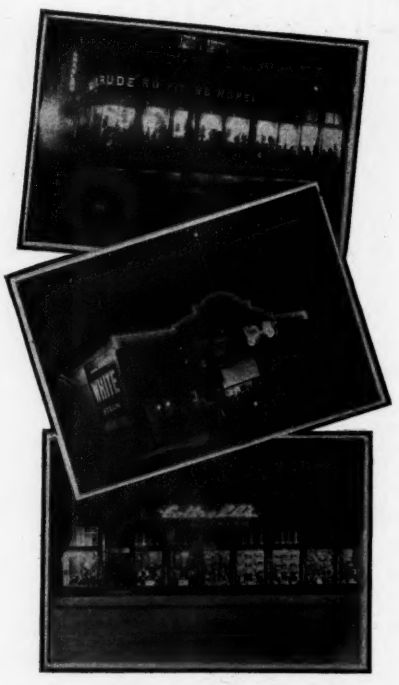
This company has been pushing things along electrical lines for some years past, altogether contrary to the annals of central station operation in small cities, with the gratifying results commented upon.

It has succeeded in making a capital showing in almost every class of business which it has gone after, and has succeeded against good, aggressive gas competition.

The flaming arc lamps, above mentioned, were introduced and found an effective means of putting the gas arc in the shade. Heroic measures were adopted at the time of the introduction of the first electric sign, current being furnished free for one year in the case of a certain leading merchant, but this was found to be an excellent opening wedge, as many others, who paid for the current, were forced into line, with the result that to-day there are twenty or thirty signs in operation, six of which are eighty to one-hundred-lamp signs.

This is a remarkably good showing for so small a city.

As an example of the aggressiveness of this company and its officials, we cite the case that several years ago they made a



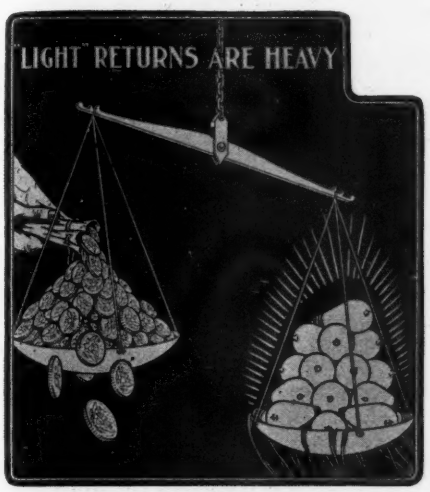
A few suggestive hints for the attractive treatment of show-window lighting and the efficient arrangement of electric signs and border lights.

display of the Cooper Hewitt vapor arc lamp in the windows of the company's display room several months before it was shown even in some of the largest cities.

F. W. Hawley, who is manager, is a hustler from the word go, and sticks at nothing, so far as hard work is concerned, to get new business on the company's books. He also is a believer in direct-by-mail advertising to pave the way for solicitors, to interest and educate the people, to break the ice and to bring inquiries.

The company has mapped out and contracted for a residence advertising service

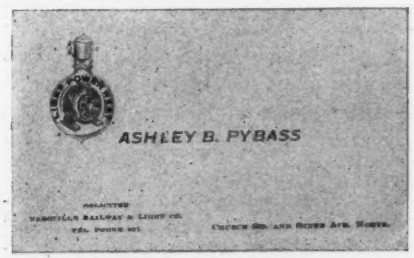
to cover the year 1907, for it believes it takes repeated effort to get the advantages of electricity firmly impressed on the people's mind and to insure the company against being forgotten. By following out its logical, sensible, penetrating system of advertising to the homes, on the nature



A forcible and well-designed folder sent out by the Edison Illuminating Company, of Brooklyn, N. Y., to its local merchants. It is strongly written and has a return postal attached for the convenience of merchants who wish to go further into the matter of lighting their business places electrically.

of electrical service the people need, this company can not fail to attain a wide range of success.

Its advertising consists of folders, mailing cards, booklets and fac-simile typewritten letters, attractively gotten up, well illustrated, strongly and convincingly written, well printed and sent out once every month during the year to a carefully selected list of prospects and all customers.



A well-gotten-up and attractive solicitor's card, printed in three colors and embossed. It is suggested that central stations furnish their solicitors with such suggestive and handsome cards. It places them above the average solicitor, and they are apt to receive better and more courteous attention.

The company reports an increase of 250 new customers during the past year, and it is sure that the present year will show an even more creditable increase.

Some of the things which have been done by the company sound like the activities of a central station in a really large city. For instance, it has had a cooking demonstrator there, got out menus, invitations, etc., and has out a campaign on electrical cooking, with the result that to-day there are in Ludington quite a number of electric kitchens; more, certainly, than will be found in some cities twenty to fifty times the size of Ludington. This class of business has been especially encouraged and fostered by the introduction of a low rate of three cents per kilowatt-hour for cooking circuit.

Almost all the valuable and desirable commercial and power business is already sewed up tight by this aggressive company, and a special campaign of direct-by-mail advertising is about to be inaugurated, directed toward the requirement of new residence business.

One feature which makes it possible for this plant to give very low rates is its ideal situation with regard to current generation. The proprietors of the company also own a lumber plant, the refuse from which is sufficient fuel for the generation of the current, enabling it to make meter rates from five and one-half cents to eleven cents per kilowatt-hour.

An evidence of the broad-minded and thoroughly up-to-date policy of this company was afforded in a recent instance where an accident occurred to a certain small group of consumers served by a certain line, by which these consumers were put to a great deal of annoyance through the interruption of the service. The company immediately got out a circular letter to these consumers, explaining the cause of the trouble and assuring them that it had been remedied and would not occur again, and at the same time notified them that a special ten per cent rebate would be given to them by the company.

It is things like this which overcome prejudice and make friends worth having.

Electricity at Jamestown.

Electric power for the approaching exposition at Jamestown, like that at the Buffalo Pan-American Fair, will come from a distance. Having no Niagara to rely upon, however, power for the Jamestown Exposition will be furnished by steam turbines located in the power-house of the Norfolk Railway and Light Company, about seven miles from the exposition grounds. This fair will be the first at which the electric power will be generated by steam turbines. The machines will be of the Curtis type, these, as well as the complete electrical equipment, being supplied by the General Electric Company.

The exposition authorities have entered into a contract with the Norfolk Railway and Light Company to furnish all the electricity required for illumination and power purposes. The electricity generated at the Jamestown power-house will be transmitted on specially constructed lines to a model substation in Machinery Hall. Here will be located the transforming and distributing apparatus. This equipment consists of large air-cooled transformers, many smaller, type H, transformers for general illumination, as well as constant-current transformers for the series arc lighting system which will be used for police illumination. At the substation also are motor-generator sets to provide direct current for the operation of searchlights and small motors where they may be installed by exhibitors.

The switchboard for controlling the various circuits throughout the exposition grounds is located in a gallery and is typical of modern switchboard engineering. All the electrical machinery follows standard lines similar to that installed at the St. Louis, the Pan-American and other American expositions.

Those who have seen the plans of the Jamestown Exposition predict that the electrical features, particularly the illumination, will equal, if not excel, the display at the famous Pan-American Exposition. Thousands of incandescent lamps will be supplemented by searchlights both on land and on the fleets anchored in Hampton Roads, combining to make the nightly pageant magnificent and beautiful.

Bonus for Electric Smelting.

The Government of the Dominion of Canada has granted a bonus on all ore smelted by electricity. The decision is the outcome of what are said to have been successful experiments made at Soo, Ont., under the supervision of the Government. The bounties are as follows: On pig iron manufactured from Canadian ore by the process of electric smelting, during the calendar years: 1909, $2.10 per ton; 1910, $2.10 per ton; 1911, $1.70 per ton; 1912, 90 cents per ton. On steel ingots manufactured by electric process direct from Canadian ore and on steel ingots manufactured by electric process from pig iron smelted in Canada by electricity, from Canadian ore, during the calendar years: 1909, $1.65 per ton; 1910, $1.65 per ton; 1911, $1.05 per ton; 1912, 60 cents per ton.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Holophane System of Illumination.

The correct application of fundamental mathematical laws in establishing the correct design of illumination for any given area requires long experience, careful calculations, good judgment and a fine sense of the artistic. While it is generally best to take up any engineering problem directly on the ground, it is nevertheless possible, in most cases, to correctly design the illumination for any given area by a study of the plans and elevations of the building or room.

As an example of what it is possible to do by careful design may be mentioned one large public building recently completed. This building was originally designed for the equivalent of 20,000 sixteen-candle-power lamps. Although the outlets were not placed so as to get the maximum results, nevertheless by careful study of conditions, correct design of fixtures for illuminating as well as artistic effect, and the selection of the right glassware for each place, the load has been reduced to the equivalent of 15,000 eight-candle-power lamps, resulting in a saving of over $25,000 annually.

By the selection of scientifically constructed glassware it is possible to obtain perfect diffusion and at the same time direct the maximum amount of light in the desired direction. This is one of the strongest features of the well-known Holophane system of illumination.

In communicating with any of the engineering departments now being maintained by many up-to-date companies in this field it is advisable to send drawings or blue-prints of the buildings to be illuminated, giving, if possible, the location of furniture, the uses to which each room will be put, color scheme, etc.

It is often possible to get good results in a number of different ways, thus affording rather a wide latitude in the matter of preference as to what method of illumination is wanted, such as ceiling lighting, bracket lighting, etc.

The Holophane Company, New York, N. Y., has been a pioneer in the movement toward better illumination and has established an engineering department whose force is composed of some of the best-known illuminating engineers. A large number of extremely efficient and artistic installations show commendable results of the expert efforts of this staff, whose services are offered to those interested free of charge, whether or not it is desired to use the Holophane system of illumination.

The Benjamin "Anti-Night."

The accompanying illustrations show the new form of cluster placed on the market by the Benjamin Electric Manufacturing Company, Chicago, Ill., which has been designated the "Anti-Night." This is a fixture form measuring twenty-five inches over-all. It is especially adapted for lighting stores, halls and public buildings, and is highly ornamental in design. The cluster body is finished in polished aluminum. The fixture, from reflector to top of bottom lamp, is snow white, and all shadows are eliminated.

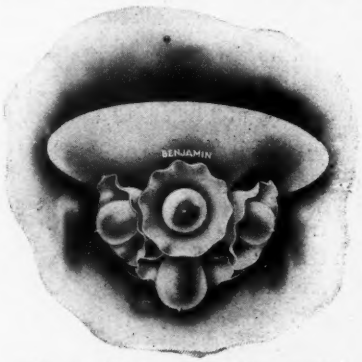


FIG. 1.—CEILING FORM BENJAMIN "ANTI-NIGHT."

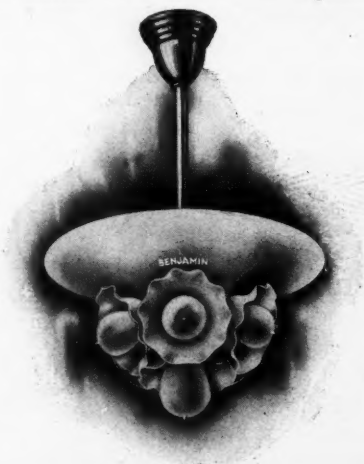


FIG. 2.—PENDANT FORM, BENJAMIN "ANTI-NIGHT."

The fixture is equipped with special shade-holders which permit the removal of reflectors without disturbing the electrical connections.

Fig. 1 shows the style C3 ceiling form, and Fig. 2 shows the style D3 pendant form.

By using a special wall switch furnished by the company, the inner and outer lamps may be operated independently of each other, thus securing three degrees of illumination. The "Anti-Night" with turndown feature can be operated by using two single-pole switches, either wall or pendant, each switch operating one of the groups.

A New High-Voltage Insulating System.

F. M. Locke, of Victor, N. Y., who has been well known for many years in connection with the development of high-voltage insulators, announces a new system of insulation for high-voltage transmission, as the result of nearly three years of practical laboratory study and experiment.

Mr. Locke claims for this system that it is practically unlimited as to its electrical and mechanical strength. Under this claim he includes the arcing distance, spray tests, puncture tests, creeping surface and mechanical endurance features. According to Mr. Locke's statements, this system has been successfully tested in one of its forms up to 300,000 volts, under a precipitation of one foot in five minutes, without arcing or showing static stresses. The inventor adds that 300,000 volts is not a limitation, as the principle of construction allows the system to be carried up to any potential desired.

"In this scheme of insulation," says Mr. Locke, "I have worked on the theory that the tendency toward bigness in insulators has reached its limit, and in this new method far greater capacity is accomplished with smaller sizes of insulators, thereby simplifying the engineer's problem of permanent construction, and at a minimum cost." Mr. Locke adds: "If you will notice the Niagara-Syracuse line, carrying 60,000 volts, you will see that the tops of the poles have been burned by electrical leakage, a constant difficulty in high-power transmission; and in this case it is noteworthy because the insulators employed are of excellent design and manufacture, and were installed by an eminent engineer, according to approved methods. It is this matter of current leakage also which I claim my new system entirely eliminates."

The Milwaukee Trip of the Ohio State University Students.

That Milwaukee, Wis., is one of the most interesting manufacturing centres of machinery and electrical apparatus, is demonstrated by the many visits of parties of students from technical schools, eager to supplement the knowledge they have gained in the class-rooms with an insight into the practical side of their profession. The latest party of students to visit Milwaukee was the class in electricity of the Ohio State University, a group photograph of which is shown herewith. This photograph was made at the works of the Cutler-Hammer Manufacturing Company on March 27.

OHIO STATE UNIVERSITY STUDENTS' ELECTRICAL CLASS AT THE WORKS OF THE CUTLER-HAMMER MANUFACTURING COMPANY, MILWAUKEE, WIS.

The students left Columbus, Ohio, on March 24, and returned to the university on March 31. A third of the time allotted to the trip was spent in Milwaukee. Among the other cities visited were Chicago and Cincinnati. While in Milwaukee the students were the guests of the Allis-Chalmers Company at a luncheon at the club-house at West Allis. The party was in charge of Professor Francis Cary Caldwell, and consisted of the following students: Norman R. Work, J. L. Grant, R. W. Hall, Carl E. Pool, W. S. Williams, H. W. Conrad, Charles P. Cooper, J. G. Stewart, D. S. Moore, H. A. Seabright, W. H. Steuve, C. P. Galleher, S. E. Gillespie, William E. Larzelere, Charles W. Yerger, James Y. Haring, R. E. Hecker, George B. Thomas, H. M. Olds, George L. Eiselstein, W. O. Dean, M. B. Evans, Frank W. Funk, O. G. Galland, R. H. Penn, A. H. Heitmann, R. R. Hazlitt, H. I. Dodson, John C. Slager, L. W. Roush, J. I. Sample, G. B. Schneeberger, Ernest R. Dike, Clarence T. Evans, Elmer A. Cooke, William G. Mullin, H. A. Cowgill, E. E. Moore, F. A. Zink, M. Erlanger, Lertin Ridenour, H. S. Knerr, Lee H. Shinkle and H. M. Crossman.

An Interesting Heating and Ventilating Installation.

The new electrical engineering building of Worcester Polytechnic Institute, which is to be completed this fall, and which will be one of the largest of its kind in the country, costing over $125,000, is to be equipped with a complete heating and ventilating outfit supplied by the Green Fuel Economizer Company, of Matteawan, N. Y.

The general laboratory is 200 feet long by fifty feet wide, containing three galleries, 19,400 square feet of floor space and about 400,000 feet of cubic contents. Besides this, there will be in the west wing a lecture hall for seating 300 persons, above which will be standards and research laboratories, while the east wing will contain a library and offices, designing rooms, blue-print rooms and recitation rooms.

The equipment for supplying warm air to this space will consist of a Green cone fan, six feet in diameter, drawing the air through a tempering coil consisting of six Green heater sections, each containing 2,544 lineal feet of pipe. The air from the fan can pass either directly to the rooms or through another heater consisting of four sections and containing 2,640 lineal feet, or part of the air may be passed one way and part the other and the two volumes of air mixed in suitable proportions to regulate the temperature. The heaters are of a new design, being made up of straight pipe expanded into headers. By removing the covers of the latter, any pipe can be inspected, cleaned or removed. As circulation is positive, the heater can not become air-bound. It is adapted for live or exhaust steam and hot or cold water.

Great Northern Railway to Use Electricity.

Electricity will be utilized by the Great Northern Railway Company, instead of steam, as the motive power on at least one division of its transcontinental line in North Dakota, as well as for hauling trains through the Cascade Tunnel in the Rocky Mountains. The stretch of road where it has been decided to use electricity is between Minot and Williston. It is said that on this run the water is so bad that the locomotive boilers must be cleaned after each trip, because of the deposits taken up in the water.

Current Electrical News

DOMESTIC AND EXPORT.

PROPOSED NORTH CAROLINA POWER DEVELOPMENT—R. L. Wiede, a civil engineer of Washington, D. C., is preparing plans for a large electric and water-power plant, near Linville, Burke county, N. C., which will be installed at a cost of $1,500,000. The site is in a deep gorge in the heart of the mountains, fifteen miles from a settlement of any size. There is said to be an enormous amount of power available at the proposed site.

NEW CALIFORNIA STREET RAILWAY SYSTEM—Articles of incorporation of the San Jose Traction Company have been filed with the county clerk. The company is formed to build and operate an electric railway in the city of San Jose, Cal. The incorporators of the new company are L. E. Hanchett, who takes the greater part of the subscribed stock, John Martin, S. S. Baldwin, C. C. Benson and E. M. Rea. The directorate corresponds with that of the San Jose & Santa Clara County Railway Company. The capital stock of the new company is $1,000,000. Of this amount $300,000 has been subscribed by the five persons named.

LONG SOUTHERN TROLLEY ROAD PLANNED—It is announced that the Alabama Land and Improvement Company has completed all plans for the immediate construction of an electric freight and passenger railroad from Birmingham, Ala., to Chattanooga, Tenn., a distance of 150 miles. Rights of way have already been secured. The road will go by the way of Albertville, at the east end of Sand Mountain, where it will connect with boats on the Tennessee river and will also cross the river. It will open a rich new region in the Sand Mountain locality. Several of the streams will be dammed and power thus secured.

REPORTS OF MANILA ELECTRICAL SYSTEMS—The Manila (Philippine Islands) Electric Railroad and Lighting Corporation reports for the twelve months ended December 31, 1906, as follows: Receipts from dividends and interest, $352,595; miscellaneous expenses and interest, $235,565; net profit, $117,030; surplus December 31, 1905, $59,480; total net profit, $176,510; dividends, $99,560; surplus, $76,950. The income account of the Manila Electric Railway and Lighting Company, also operating La Electricista, for the year ended December 31, 1906, is as follows: Gross, $894,959; expenses and taxes, $453,682; net, $441,277; interest, $180,000; surplus, $261,277; dividends, $151,666; net surplus, $109,611; previous surplus, $139,699; total surplus, $246,310.

NEW OKLAHOMA ELECTRIC LINE—A charter has been issued from the territorial secretary's office to the Oklahoma City, El Reno & Southwestern Electric Railway Company, with a capital stock of $10,000,000. The principal business offices are to be located at El Reno. The company proposes to build an electric line from Oklahoma City to El Reno, thence to Chickasha, Anadarko, Hobart and Lawton, and a branch line from El Reno to Kingfisher, Hennessey, Enid and Medford; also a branch line from Kingfisher to Okeene, by way of Kiel, passing through the following counties: Oklahoma, Canadian, Caddo, Kiowa, Comanche, Kingfisher, Garfield, Grant, Blaine and a part of Chickasaw nation. The estimated length of the road is 275 miles. The incorporators are: Fred Ehler, J. W. Smith, C. C. Smith and E. B. Cockrell, of Hennessey; W. R. Blackburn, of Kingfisher.

LONG ISLAND RAILROAD COMPANY'S ANNUAL REPORT—The twenty-fifth annual report of the Long Island Railroad gives a detailed account of the improvements made on the line in 1906. The work on Atlantic avenue, Brooklyn, has been confined to the freight and passenger terminals. The terminal work should be completed this year. The new yard for the Sea Beach Railway is about completed and ready for delivery in exchange for the property on which the Sea Beach terminal is now. Several of the principal grade crossings have been eliminated. The section of the road from Springfield Junction to Valley Stream has been electrified, thus completing a loop service from the Far Rockaway branch to the Old Southern road, making a total of 100 miles now operated by third rail. Plans are under way for the electrification of the line from Long Island City to Port Washington and to Whitestone Landing. As soon as the terminals under the East river are completed the lines to Jamaica and Woodhaven will also be electrified. The deficit of $28,358 in the income account is explained by the increase of interest charges and the loss in the operation of the Montauk Steamboat Company amounting to $56,821.

PERSONAL MENTION.

MR. W. G. SLACK has been appointed acting secretary-treasurer of the Bell Telephone Company of Canada, succeeding the late C. B. Sclater.

MR. JOHN DEWBERRY, of Elyria, Ohio, has succeeded B. M. Reesor as manager of the Middletown (Ohio) office of the Central Union Bell Telephone Company.

MR. CHARLES F. BOYNTON, formerly of the New York city department of electricity, water and gas, has become connected with the National Metal Molding Company, at its down-town office, New York city.

MR. F. F. SMITH, who has been superintendent of the plant of the Merchants' Heat and Light Company in Indianapolis, Ind., has accepted a similar position with a new heat and light company at Salt Lake City, Utah.

MR. H. C. PAGE, general manager of the Springfield (Mass.) Street Railway Company, and who was formerly manager of the Berkshire (Mass.) Street Railway Company, has been chosen president of the New England Street Railway Club.

MR. J. W. BEEMER, for several years chief electrician and superintendent of the Pinckneyville (Ill.) Electric Light Company, has resigned to accept a similar position with the Duquoin Utility Company, which is installing an electric-light system in Duquoin, Ill.

MR. FRANK C. NEWELL, consulting engineer, formerly with the Westinghouse Air Brake Company, Pittsburg, Pa., and residing at 434 Rebecca avenue, Wilkinsburg, Pa., has moved to Cleveland, Ohio, where his headquarters will be in the State Bank Building, 734 Euclid avenue.

MR. M. J. KINCH, superintendent of the Green Bay (Wis.) Traction Company, and in charge of the electrical department of the Green Bay Gas and Electric Company, has also taken over the management of the latter company's gas department, succeeding Howard Bixby.

MR. H. L. WILLS, contract agent of the Georgia Railway and Electric Company, Atlanta, Ga., has resigned to undertake the management of the Savannah (Ga.) Light and Power Company. He will be succeeded by W. Rawson Collier, of Atlanta. The employés of the contract department tendered Mr. Wills a farewell banquet.

MR. F. H. DANIELS, chief engineer of the American Steel and Wire Company, who has returned from Europe, spent several months traveling in England, Germany, Holland, Austria, Belgium, France, Luxemburg and Italy, where he inspected the improvements in various industrial plants. He calls attention to the success which the Germans have attained in fuel economy.

MR. ADOLPH H. MAY, for the past three years manager of the Western Union Telegraph Company's Salt Lake City, Utah, office, has been appointed superintendent of the Pacific division. He is succeeded by Arthur W. Long, who has been connected with the Salt Lake City office for many years. Mr. May began his career as a messenger with the Western Union in Hastings, Neb. From messenger he was advanced until he was made manager of the

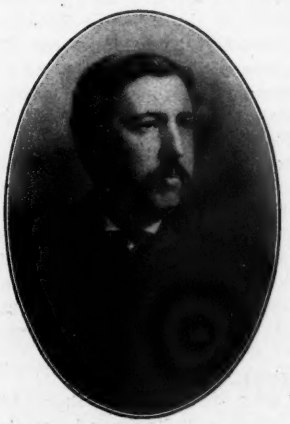
Western Union office in Lincoln, Neb. Three years ago he was transferred to Salt Lake as manager.

MR. J. BOISE POTTER has been appointed manager of the Stamford and Port Chester divisions of the Consolidated Railway Company, of New Haven, Ct., in the place of E. R. Gilbert. His headquarters will be in Port Chester, N. Y., and all the surface lines of the Consolidated between Darien, Ct., and New York city will be under his management. Mr. Potter was formerly superintendent of the local system of the Consolidated company at Putnam, Ct.

MR. E. P. DILLON has been appointed general manager of the Pike's Peak Hydro-Electric Company, Colorado Springs, Colo., to fill the vacancy made by the recent resignation of G. A. Taff. Mr. Taff resigned as general manager of the company because of his extensive interests elsewhere. He is still a consulting engineer of the company. Mr. Dillon was formerly chief electrical engineer of the Colorado Springs Electrical Company. He resigned that position two months ago.

MR. MASON B. STARRING, formerly vice-president of the Chicago (Ill.) City Railway Company, has assumed the duties of president of the Northwestern Elevated Railroad Company, succeeding Clarence Buckingham. His election took place recently. One of the first tasks he has to perform is the completion of the Ravenswood extension. Mr. Starring is a native of Chicago, was educated in the public schools and has been in the railway business since early youth. In the beginning of his career he was employed in the operating departments of the Burlington and the Pennsylvania roads. In 1888 he went to the Chicago City Railway Company as a clerk, studied law under William J. Hynes and J. S. Grinnell and advanced until he became vice-president and general solicitor of the company.

MR. WILLIAM HENRY BAKER, because of his continuous and arduous labors during the nearly twenty years of his connection with the Postal Telegraph-Cable Company, has asked to be relieved from the detailed duties of vice-president and general manager, and his resignation from that office has therefore been accepted. Mr. Baker will continue to act in an advisory capacity, his duties, with the title of vice-president and general manager, being assumed by Edward J. Nally. Mr. Baker is one of the best known and most esteemed men in the telegraphic field. He was born in Buffalo, N. Y., April 13, 1855. When he was fifteen years old he entered the employ of the Western Union Telegraph Company, in the office of A. B. Chandler. Later he was assigned a clerkship under the direction of Edward C. Cockey, who was then in charge of the general superintendent's office, having oversight of the accounts of all superintendents of the eastern division of the Western Union Telegraph Company. Mr. Baker continued in various capacities in the service of both the Western Union and the Atlantic and Pacific Telegraph companies, including the secretaryship of the latter company. Early in 1885 he accepted the secretaryship of the American Electric Manufacturing Company. He resigned from this position later and bought a membership in the New York Stock Exchange. He soon disposed of these interests and entered the service of Theodore N. Vail, then president of the Metropolitan Telephone Company. In the fall of 1889 he was invited to accept a vice-presidency of the Postal Telegraph-Cable Company, and assumed the duties pertaining to this position on the first of November of that year. He is a director of the American District Telegraph Company, of Philadelphia; Commercial Cable Building Company, Commercial Union Telegraph Company, New England Telegraph Company, New York Quotation Company, Otis Elevator Company, Pacific Postal Telegraph-Cable Company, Postal Telegraph-Cable Company, Postal Telegraph-Cable Company, of Texas; Sprague Elevator Company, and president, manager and director of the Postal District Messenger Company. He is a member of the Hardware Club and the New York Press Club.



MR. WILLIAM HENRY BAKER.

ELECTRICAL SECURITIES.

Contrary to local public expectation, but following the predictions of the banking interests, the market was irregular, with a decidedly sagging tendency. The prices show general declines as compared with a week ago. A period of dulness is generally the aftermath of a succession of fluctuations such as the market has recently passed through. It is felt by many that this period of inactivity is now holding sway in the market, and there seems to be no very general idea as to the outlook for the immediate future. The investor, seeing the rapidity with which prices advanced from the low mark reached about two weeks ago, naturally feels cautious; and the withdrawal of thousands of such from the market just as naturally makes for a shrinkage in business and a consequent fall in the prices of many stocks which, following the decline just mentioned, were repurchased for speculative purposes only.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 13.

New York:	*Closing.*
Allis-Chalmers common	12⅜
Allis-Chalmers preferred	34½
Brooklyn Rapid Transit	58½
Consolidated Gas	128
General Electric	147
Interborough-Metropolitan common	24½
Interborough-Metropolitan preferred	59⅞
Kings County Electric	126
Mackay Companies (Postal Telegraph and Cables) common (ex-dividend	70
Mackay Companies (Postal Telegraph and Cables) preferred (ex-dividend)	69
Manhattan Elevated	137
Metropolitan Street Railway	100
New York & New Jersey Telephone	111
Western Union	82
Westinghouse Manufacturing Company (ex-dividend)	147

Orders received by the Westinghouse Electric and Manufacturing Company during March represent a greater value than the business of any previous month in the history of the company, aggregating over $4,000,000. Since January 1, there has been no let-up in the record-breaking business of last year, and there are even now sufficient orders in the various departments of the East Pittsburg works to keep the shops employed to their full capacity during 1907.

Boston:	*Closing.*
American Telephone and Telegraph	122
Edison Electric Illuminating	202
Massachusetts Electric	59½
New England Telephone	119
Western Telephone and Telegraph preferred.	74

The following directors of the American Telephone and Telegraph Company have been selected to form the executive committee: Henry S. Howe, W. Murray Crane, John I. Waterbury, Theodore N. Vail, and *ex officio*, President Frederick P. Fish.

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	54¾
Electric Storage Battery preferred	54¾
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	17¼
United Gas Improvement (ex-dividend)	88⅞

It is estimated that the March gross earnings of the Philadelphia Rapid Transit Company showed an increase of $80,000 to $90,000 over the corresponding month of 1906.

With rates charged for lighting materially reduced, as they were in February, 1906, the earnings of the Philadelphia Electric Company last year, as shown by the annual report at the stockholders' meeting, were more than maintained. Gross receipts for the year were $4,503,078, compared with $4,104,113 for 1905, and net income was $820,717, compared with $811,016 the year before. These increased returns resulted from large expansion of the company's business, which President McCall ascribes to the stimulus of lower rates.

Chicago:	*Closing.*
Chicago Telephone	118½
Chicago Edison Light	147
Metropolitan Elevated preferred	65
National Carbon common	71
National Carbon preferred	110
Union Traction common	—
Union Traction preferred	—

The Metropolitan Elevated is planning a surface extension to Clyde, Ill., to cost $100,000.

Chicago Edison earnings the last fiscal year are reported to show ten per cent increase. The Commonwealth annual meeting will be held May 20, and the Edison annual meeting June 10. The annual reports will be issued next month.

NEW INCORPORATIONS.

HOUGHTON, MICH.—Mutual Light, Water and Power Company. $500,000.

INDIANAPOLIS, IND.—Big Spring Telephone Company, Boone county. $10,000. Directors: Addison Higbee, Ellis Edwards and C. A. Berry.

MADISON, WIS.—The Shields Telephone Company, Germania, Marquette county. $5,000. Incorporators: J. A. Schalow, G. W. Grahn and others.

AUGUSTA, ME.—Etna Telephone Company, Etna. $5,000. President, L. P. Toothaker, Dixmount, Me.; treasurer and clerk, A. L. Sylvester, Etna, Me.

MADISON, WIS.—The Kegonsa Independent Telephone Company, Pleasant Springs, Dane county; an amendment increasing its capital from $1,000 to $3,000.

AUGUSTA, ME.—The Toledo, Wabash & St. Louis Electric Railway Company. $6,000,000. To build an interurban system between Toledo, Ohio, and St. Louis, Mo.

SANTA FE, N. M.—The Craig Water and Light Company, of Texico, Roosevelt county. $25,000. Incorporators and directors: D. F. Craig, of Independence, Mo.; R. C. Reid and G. E. Reid, of Texico.

LOS ANGELES, CAL.—Silver Lake Power and Irrigation Company, of Reno, Nev. $5,000,000; subscribed, $100,300. Directors: Dr. Ernest Angermann, J. S. Parker, Walter S. Fifield, Lee J. Davis.

SPRINGFIELD, ILL.—Lincoln Railway and Light Company, of Lincoln. $2,500. To operate street railways, light, heat and power plants. Incorporators: M. O. Payne, Charles H. Scott and Thomas Marshall.

NASHVILLE, TENN.—Elk Valley & Oneida Railway Company, Campbell county. $50,000. Incorporators: H. C. Lindsay, R. S. Young, C. H. Smith, R. N. Kesterson and J. O. Smith. To construct a railroad from Elk Valley, Campbell county, to Oneida, Scott county.

JERSEY CITY, N. J.—Pennsylvania Telephone Company, of New Jersey. To construct telephone and telegraph lines in Pennsylvania. $50,000. Incorporators: Leonard H. Kinnard, Harrisburg, Pa.; Addison Candor, Williamsport, Pa., and Samuel S. Moore, Elizabeth, N. J.

CHARLESTON, W. VA.—The Elkins Electric Railway Company, of Elkins. To build and operate an electric railroad in Elkins. $50,000. Incorporators: J. C. McSpadden, of Rockwood, Pa.; W. K. Taylor, of Pittsburg; J. E. Morgan and C. W. Maxwell, of Elkins, and H. F. Berkebile, of Rockwood.

SPRINGFIELD, ILL.—Virden & Taylorville Traction Company. To construct an electric line from Virden, in Macoupin county, to Taylorville, in Christian county. $2,500. Incorporators and first board of directors: H. C. Simon, John Colderm, W. E. Allenson and T. B. Teney, of Virden, Ill., and E. E. Barclay, of Springfield.

HARRISBURG, PA.—Greensburg & Western Railroad Company; to construct and operate ten miles of electric railroad from Greensburg to Irwin; $60,000; William S. Kuhn, of Pittsburg, president. Ellwood City & Hazel Dell Company; to construct four miles of electric railroad in Lawrence county; $25,000; C. J. D. Strohecker, of Zelienople, president.

TOPEKA, KAN.—The Kansas Traction Company. $25,000. To construct and operate a standard gauge road, either steam or electric, from Coffeyville to Kansas City, Mo., a distance of 260 miles, traversing Labette, Neosho, Allen, Anderson and Franklin counties to Topeka, thence through Shawnee, Douglas and Johnson counties to Kansas City. Incorporators: F. B. Shirley, E. C. Kiddoo, S. D. Frazier and W. C. Hall, all of Coffeyville.

YOUNGSTOWN, OHIO—Lake Erie & Youngstown Railroad Company. $10,000. To build an electric line between Youngstown and Conneaut. Incorporators: G. M. Brown, Conneaut; Wilbur F. Stanley and George J. Chapman, Conneaut; Frank J. Cheney, Toledo; John H. Ruhlman, Youngstown; William H. Ruhlman, North Lima, and A. W. Jones, Burg Hill. The line will parallel the Lake Shore road for some distance.

OBITUARY NOTES.

MR. EDWARD C. NICHOLS, vice-president of the South Side Elevated Railroad, Chicago, Ill., died at his home in Maywood, Ill., on March 28, of pneumonia, after an illness of two weeks. Mr. Nichols was born at Maywood, Ill., in 1870, and attended the public schools of that village until he entered the University of Michigan, from which he was graduated in 1892. He later entered the law department of the University of Chicago, and, after finishing his course there in 1894, entered the service of the South Side Elevated Railroad as attorney. He held this position for twelve years and at the annual meeting of the company on January 31 of this year was made vice-president, succeeding T. J. Lefens, resigned.

MR. HENRY W. GOODE, president of the Portland (Ore.) Railway, Light and Power Company, and its several subsidiary companies, died at Atlantic City, N. J., on March 31, aged forty-six years. For many years he had been prominently identified with the electric traction, light and water-power interests of the country. At one time he was district director of the Westinghouse Electric and Manufacturing Company, of Pittsburg, subsequently becoming president and general manager of the Northwest General Electric Company. In 1892 he was elected president of the Portland General Electric Company, and later, when the Portland Railway, Light and Power Company was formed as a holding company for the Portland Railway, the Portland General Electric and the Oregon Water Power and Railway companies, Mr. Goode was chosen its president. He also was president and director-general of the Lewis and Clark Exposition at Portland in 1905, and president of the West Coast Fair of 1905.

M. EDOUARD HOSPITALIER, the distinguished French electrical engineer, died recently in Paris, France, at the age of fifty-four. He was born in August, 1852, the son of a French army officer. He was educated at the Ecole d'Arts et Metiers, of Aix, and in 1877 was graduated from the Ecole Centrale with a diploma in mechanical engineering. He took up journalism, joining first the staff of *La Lumiere Electrique*, in 1879. In 1881 he joined *L'Electricien*, and in the same year was appointed a member of the committee of the International Congress of Electricians. He was made professor of electrical engineering at the Ecole de Physique et de Chimie Industrielle in 1882, a school just created by the city of Paris. The appointment did not necessitate his abandoning his journalistic work, and in 1883 he became editor-in-chief of *L'Electricien*. He also contributed frequently to *La Nature*. In 1890 he resigned from *L'Electricien* and founded *L'Industrie Electrique*, remaining editor-in-chief of this paper up to the time of his death. M. Hospitalier was the author of numerous books on electrical subjects, and an active member of the Société Internationale des Electriciens, finally becoming president of that body. He also devised a number of interesting and valuable pieces of apparatus, one of these being the Ondograph. He received many honors, being made an officer of the French Academy in 1888, Commander of the Order of the Crown of Italy in 1899, and Chevalier of the Legion of Honor in 1900.

LEGAL NOTE.

TYPE K ELECTRIC CONTROLLERS—In the United States Circuit Court for the District of New Jersey, a preliminary injunction was granted in a suit brought by the General Electric Company to restrain the Sunday Creek Company from the further use of series-parallel controllers manufactured by the Morgan-Gardner Electric Company, of Chicago, Ill., it having been held in a prior suit against another user, the Garrett Coal Company, that such controllers infringed the Knight & Potter patents Nos. 587,441 and 587,442, issued August 3, 1897. Judge Cross grants the injunction against the Sunday Creek Company, giving that company, however, seventy-five days from the date of the opinion in which to change its controllers or adjust its business so as not to further infringe these patents. These patents cover what is generally known as the "K" type of controller, or the type in which the motors are changed from series to parallel connection by the shunting of one motor as opposed to the method in which the circuit is opened while the change from series to multiple connection is made. The Sunday Creek Company is a large coal-mining concern operating in Ohio and West Virginia, but is incorporated under the laws of New Jersey. The controllers involved in this case were used on mining locomotives. Under the patent agreement existing between the two companies only the General Electric and Westinghouse companies can manufacture these controllers.

ELECTRIC LIGHTING.

MOUNT AYR, IOWA—The town has voted for a lighting plant.

BOWLING GREEN, OHIO—Fire destroyed the A. G. Henry electric lighting plant at North Baltimore on March 25, entailing a loss of $25,000.

SANTA FE, N. M.—The Albuquerque Gas, Electric Light and Power Company has filed additional incorporation papers increasing its capitalization from $200,000 to $500,000.

ROCK VALLEY, IOWA—R. A. Talbot has been granted an electric lighting franchise by a vote of 129 to 63. The Sioux City & Ireton Electric Railway Company was also given a franchise to use the streets.

TEMPLE, TEX.—A half interest in the Temple Electric Light Company has been disposed of by Frank E. Merrill, of this city, the secretary and general manager of the company, the purchasers being J. Z. Miller, Jr., of Belton, and J. E. Ferguson, of Temple.

ARGENTA, ARK.—The city council has decided to purchase the new electric light plant from the Argenta Light and Power Company for $50,000. The plant was recently completed by the O'Neil Engineering Company, of Dallas, Tex., for the Argenta Light and Power Company, and at present operates sixty arc lamps.

KNOXVILLE, TENN.—Col. T. B. Burridge, of Denver, with two associates, one of whom is an engineer, has been looking over the proposition to build a dam and power plant on the Little Tennessee river to supply power for Knoxville. The proposition is an old one enlarged. Instead of building a $2,000,000 plant they propose to build a $3,500,000 plant.

GALENA, ILL.—The Dubuque & Southwestern Wisconsin Railroad Company has purchased the municipal lighting plant at Galena, and also taken over the contracts for lighting Galena for twenty-five years. The plant never has been profitable, and was built on a bond issue, the interest on which has not been paid. The new company agrees to furnish twice as much light as the city did at only a ten per cent increase in the present price.

WATERTOWN, N. Y.—Engineering experts have calculated that there is going to waste more than 1,000 horse-power of the water rights available and belonging to the Watertown Marble Company, and it is announced that the Davidson Brothers have concluded to harness the river and utilize this power. It is also announced that the promoters intend to erect and equip a modern pulp mill near the marble works, and that work will begin as soon as the plans can be prepared.

PROVIDENCE, R. I.—A reduction in the gross price of electricity for commercial lighting has been announced by Marsden J. Perry, president and general manager of the Narragansett Electric Lighting Company. The new rate will go into effect at the May readings of the meters, and will mean a saving to all users of electricity for incandescent lighting of at least twelve and one-half per cent net, while those consumers whose bills run up to $25 and over will realize a still greater saving. The reduction is a flat cut of six cents per kilowatt, bringing the price of twenty cents per kilowatt-hour down to fourteen cents.

WATERTOWN, WIS.—O. L. Huie, of Marinette, formerly with the Watertown Gas and Electric Company, has closed a deal in Milwaukee with the Isaac Stephenson Company, of Marinette, whereby Mr. Huie and business associates in southern Wisconsin have secured possession of the best water power in upper Michigan, on the Escanaba river, consisting of the power known as the Flat Rock mill site and all the power above the Flat Rock to and including Chandler's Falls. It is the intention of the parties interested to survey the water power, locate four or five dam sites and make all necessary improvements to develop the power.

SCRANTON, PA.—The resignation of E. M. Stack as general manager of the Suburban Electric Light Company was accepted at a meeting of the stockholders of the company. G. M. Tidd, of Muncie, Ind., was elected to succeed him. Henry L. Doherty, president of the American Gas and Electric Company, which recently took control of the plants of the old American Electric Company in Scranton, Pa., was elected president of the Suburban company. F. H. Ball was chosen vice-president, and Duncan Campbell was elected manager of the "new business" department. The following directors were elected: W. F. Hallstead, G. M. Hallstead, B. Moses, F. E. Platt and A. L. Francois.

TELEPHONE AND TELEGRAPH.

GALLATIN, TENN.—Telegraphic communication has been established between Gallatin and Hartsville.

GREENSBURG, PA.—The town council has closed a contract with the Bell Telephone Company for the laying of conduits.

AUGUSTA, GA.—The Western Union Telegraph Company has under course of construction a line from Augusta to Tennille, at the southern terminus of the Augusta Southern Railway.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, has announced a second reduction in rates, beginning with April 1, when extension station rates were reduced from $1 a month to fifty cents. About 9,000 subscribers are affected.

BETHLEHEM, PA.—What will be the longest private telephone in this county will soon be established between Lansford, Mauch Chunk, Allentown, Bethlehem, Quakertown, Fort Washington and Philadelphia. It will be 112 miles long and will be in operation by May 1. This line will be operated by the Lehigh Coal and Navigation Company in connection with its many collieries at Lansford and its canal, which runs from Mauch Chunk to Philadelphia.

FREDERICTON, NEW BRUNSWICK—At a special meeting of the directors of the New Brunswick Telephone Company, F. P. Thompson, who has acted as managing director, was elected president to succeed Dr. A. A. Stockton. The newly elected president will continue for the present to also act as managing director. Alfred Seely, of St. John, was appointed secretary-treasurer in place of W. E. Smith, resigned. F. B. Carvell, M. P., of Woodstock, was appointed on the board to fill the vacancy caused by Dr. Stockton's death.

WINCHESTER, VA.—At the annual meeting of the Frederick & Clark Telephone Company H. C. Warden, of Barryville, was elected vice-president and general manager, succeeding, in the latter capacity, H. F. Byrd, whose resignation as general manager was accepted to take effect April 1. Mr. Byrd remains secretary of the company. Other officers were elected as follows: Charles Mullikin, president; Shirley Carter, treasurer. The board of directors is made up of the officers and W. H. Baker, S. H. Hansbrough, Dr. W. S. Love, R. B. Smith, John B. Neill, B. McDonald and S. S. Thomas.

LOUISVILLE, KY.—As the result of an inquiry which the Louisville board of trade has been making into rates of the Cumberland Telephone Company, the local Bell system, a proposition has been made by James E. Caldwell, president and general manager of the company. After stating the position of the company in advancing rates, he declared the company was willing to leave the entire matter of the fixing of the telephone rates for the next three years in the hands of a committee of five business men. He added that at the end of the first period of three years another similar committee would be appointed by the board of trade and the rates fixed for another three years. The board of trade at once accepted the offer. The five men named by W. W. Hite, president of the board of trade, to decide telephone rates are: George Gaulbert, Attilla Cox, W. W. Belknap, Marion E. Taylor and Logan C. Murray. Mr. Caldwell promised that the employés of the telephone company would at any time give the committee any assistance it desired, and that the books of the company were open for inspection.

DATES AHEAD.

Oklahoma Electric Light, Railway and Gas Association. Annual meeting, Oklahoma City, Okla., April 22-23.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

Texas State Electric and Gas Association. San Antonio, Texas, May 14-16.

Virginia State Independent Telephone Association. Annual meeting, Norfolk, Va., May 21.

American Society of Mechanical Engineers. Annual meeting, Indianapolis, Ind., May 28-31.

National Electric Light Association. Annual meeting, Washington, D. C., June 4, 5, 6 and 7.

Association of Railway Telegraph Superintendents. Annual meeting, Atlantic City, N. J., June 19-20.

American Institute of Electrical Engineers. Annual meeting, Niagara Falls, N. Y., week of June 24.

ELECTRIC RAILWAYS.

TRUMANSBURG, N. Y.—The Ithaca & Seneca Falls Interurban Railroad Company has been granted a franchise to construct tracks and equipments in the village of Trumansburg.

LAKEVILLE, IND.—The town council has granted a fifty-year franchise to the Chicago, Goshen & South Bend Railway Company, a feeder for the New York-Chicago rapid transit electric line.

SOMERVILLE, N. J.—The New York & Pennsylvania Traction Company is planning to construct a new line from this place to Princeton, a distance of eighteen miles, during the coming summer.

GREENFIELD, IOWA—At a special election in Greenfield, a franchise and a five per cent tax were voted the American Electric Railway Company, which is behind the project to build an interurban between Des Moines and Council Bluffs.

BATON ROUGE, LA.—The electrical engineers representing the new owners of the Baton Rouge Electric and Gas Company are completing the work of preparing the plans and specifications for the rebuilding of the electrical plant and the street-car system.

FREMONT, OHIO—The contract for the construction of the Sandusky, Fremont & Southern Railway between Fremont and Vickery has been awarded to George Kinney. According to the terms of the contract, the line must be completed before June 1.

TOPEKA, KAN.—The Lawrence Electric Transportation Company has taken out a charter for a trackless trolley line in Lawrence. The company is capitalized at $200,000 and all of the money is being put up by home men. The charter was taken out by W. E. Pitts.

FAIRFIELD, IOWA—A trust deed from the Iowa-Missouri Traction and Power Company to the Knickerbocker Trust Company, of New York, has been filed in Scotland county, Missouri, and Van Buren and Jefferson counties, Iowa. The deed represents $1,000,000, which amount is to be used in building the Fairfield-Memphis, Mo., interurban.

MILWAUKEE, WIS.—William C. Soten, a Watertown banker, and others, have organized the Milwaukee & North Shore Railway Company, to run an interurban street railway from Milwaukee to Manitowoc, Sheboygan and Fond du Lac. The plans are still tentative, and those interested are not prepared to say when they will begin work.

BENTON HARBOR, MICH.—Active work has been begun on the construction of the electric line which is to connect this city with Coloma and Paw Paw lake. The Falkenau Construction Company, of Chicago, has bought the right of way and will build the line. Cars will be operated to Coloma by June 15 and to Paw Paw lake by July 1.

BALTIMORE, MD.—Contracts have been awarded the Noel Construction Company by the Maryland Electric Railways Company for the erection of the substation to be built on the north side of Lombard street, near Penn. The structure is to be used by the United Railways and Electric Company. It will be two stories high with a frontage of about fifty feet and depth of 150 feet.

POTTSVILLE, PA.—The Pottsville Union Traction Company is making extensive improvements. It is breaking ground for a large addition to the power-house at Palo Alto, to be known as the Palo Alto Light, Heat and Power Company. Two units of one thousand horse-power each will be installed. This will be a central plant to furnish light for Minersville, Tamaqua, Pottsville and vicinity.

HOUSTON, TEX.—The annual report of the Houston Electric Company for last year, filed with the clerk of the county court in compliance with the law requiring public utility corporations to file annual reports, shows that $589,047.95 was collected in fares and tickets, representing 11,780,959 passengers handled on the different lines in this city in one year, not including those riding on transfers.

ATLANTIC CITY, N. J.—Stockholders of the Suburban Traction Company have authorized the issue of $300,000 of preferred stock. Fourteen thousand shares of the total of fifteen thousand were voted in the affirmative. The company has outstanding $800,000 of stock. The line is fifteen miles long and connects Atlantic City with points along the shore of the county. The stock, according to the circular issued, is to be employed to take up outstanding claims.

MADISON, WIS.—Articles of incorporation for the Southern Wisconsin Light and Traction Company have been filed with the secretary of state. The articles provide for a bond issue of $2,000,000. The company is authorized to operate in Dane and Rock counties and is expected to build an interurban traction line from Madison to Janesville. F. W. Montgomery, president of the Madison Interurban Traction Company, is one of the incorporators.

INDIANAPOLIS, IND.—The Indiana state board of forestry, meeting at Indianapolis, acting under a law passed by the late legislature, granted the Indianapolis & Louisville Traction Company a right of way through the reservation near Henryville. It is believed that this means that a line is to be built from a point near Henryville, on the new electric line, across to Salem, the Washington county capital, and there connect with a line to French Lick.

ST. LOUIS, MO.—The East St. Louis & Southeastern Railroad Company, of East St. Louis, has filed articles of incorporation at Belleville. The company proposes constructing an electric railway from East St. Louis to Mascoutah and Freeburg, in St. Clair county. It is capitalized at $2,500 and the incorporators are: L. C. Haynes, T. W. Gregory, G. C. Pierce, James A. Farmer and Fred H. Kruger. All of the incorporators are connected with the East St. Louis & Suburban system.

ONANCOCK, VA.—At a meeting of the stockholders of the proposed trolley road held at Tasley, votes representing subscriptions of about $40,000 were cast. It was determined to build at this time from Onancock to Accomac Courthouse, *via* Tasley direct, with the probable extension to Battle Point on Matomkin Bay. For the proposed extension contingent subscriptions of nearly $10,000 were offered. The name chosen for the company was Accomack Traction and Power Company.

COLUMBUS, OHIO—The deal for the purchase of the Columbus, Urbana & Western Electric Railway, which operates a line to a point beyond the storage dam, has been completed, the property passing to the control of the Columbus & Northern Traction Company. The line will be extended in a northwesterly direction, either by the way of Hilliards or Dublin to Lima or Bellefontaine. W. H. Ogden, of Indianapolis, and J. A. Vandergrift, of Philadelphia, negotiated the deal. After the new company has been incorporated and reorganized, the work of extending the line will begin.

AMHERST, MASS.—The control of the Amherst & Sunderland Street Railway has passed to the Holyoke Street Railway Company. The Amherst & Sunderland railroad is fifteen miles in length and extends from the "notch" at the crest of the Holyoke range of mountains, where it joins the Holyoke Street Railway lines, to Sunderland, and includes a branch to West Pelham. Its acquisition gives to the Holyoke company a through line from that city to Amherst. The Amherst & Sunderland road is capitalized at $120,000. A majority of the stock is said to have been secured by parties representing the Holyoke interests at $45 a share.

PARIS, ILL.—The directors of the Terre Haute & Western Railway Company, the interurban railroad about to enter Paris from the east, have elected C. T. Mordock, of Terre Haute, president of the road. Mr. Mordock is already the manager of the Terre Haute division of the Terre Haute, Indianapolis & Eastern Railway Company. The Hon. John E. Lamb, of Terre Haute, was elected treasurer, and E. J. Davis, of Terre Haute, secretary. Frank T. O'Hair was elected vice-president of the company. The organization of this company is for the purpose of complying with the law, which requires part of the officials of Illinois interurban railroads to live in Illinois. The real control of the road, however, will be in Indianapolis, but Mr. Mordock will manage the Paris end of the line from Terre Haute. All legal obstacles are now removed, and the work on the interurban will be pushed to completion as rapidly as the weather will permit.

NEW PUBLICATION.

AMERICAN ELECTROCHEMICAL SOCIETY—Volume X of the transactions of the American Electrochemical Society has been issued. This contains a report of the tenth general meeting, held in New York during October, 1906.

NEW MANUFACTURING COMPANY.

ALBANY, N. Y.—Articles of incorporation of the New Rochelle Gas and Electric Fixture Company have been filed. The company will deal in gas, oil and electric fixtures, and has a capital stock of $4,000. The directors are William Johnson, of Mount Vernon; Charles F. Stehlin and Samuel F. Swinburne, of New Rochelle.

INDUSTRIAL ITEMS.

THE HEMINGRAY GLASS COMPANY, Muncie, Ind., and Covington, Ky., reports a good demand for its glass insulators, and has under consideration several important contracts for new transmission systems.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, Pa., has changed its representation in New York, and it is now in the hands of Fred W. Nason, 39 Cortlandt street, New York city.

THE CONNALLY-McILHERAN ELECTRICAL ENGINEERING COMPANY, Chattanooga, Tenn., has opened an office at 608 First National Bank Building, Birmingham, Ala., with W. C. McIlheran as manager, and all its Alabama business will be handled through this office.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1,057, describes a new line of direct-current motors and generators designated as type K. A number of important changes, both in mechanical and electrical design, have been made to meet the requirements of motors that can be applied to the individual driving of machinery of various kinds. This bulletin will be sent to any one interested upon request.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has found it impossible to handle its rapidly increasing business in electric motors and generators in Birmingham, Ala., from its New Orleans and Baltimore offices, and has been obliged to establish headquarters in Birmingham. The new office, which is in the Woodward Building, Birmingham, is in charge of B. A. Schroder, who hitherto has taken care of the New Orleans territory of the company.

THE SARCO COMPANY, 906 Sixth avenue, New York city, announces that Syles R. Fralick, 269 South Canal street, Chicago, Ill., is now its Chicago representative, carrying a full line of pendant switches, swivel separable attachment plugs, key arm and canopy switches, and Sarco outlet boxes. Mr. Fralick, through his long connection with the Benjamin Electric Manufacturing Company, is well and favorably known throughout the West, where he has been located for several years.

THE NILES-BEMENT-POND COMPANY, 111 Broadway, New York city, announces the removal of its Chicago offices to the new Commercial National Bank Building, Clark and Adams streets, Chicago. The Pratt & Whitney Company will abandon its showroom and offices on South Canal street, Chicago, and will combine its machinery sales department with that of the Niles-Bement-Pond Company. The showroom and stock of Pratt & Whitney small tools, and the small tool sales department, will be located on the ground floor of the Plamondon Building, Clinton and Monroe streets. George F. Mills will continue as manager of the Chicago offices.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., announces that owing to the increased demand, its plant at Third street and Penn avenue has become entirely too small. The company has been working night and day to keep up with its orders, but has found the congestion increasing constantly. New quarters are now being occupied in a special building located at 1207-1219 Washington avenue, Allegheny, Pa. The building is thoroughly equipped with modern apparatus, and the company expects to immediately settle down into a position where it can take care of its rapidly increasing business. The company makes a number of specialties, including "Star" bushings, water-tight floor boxes, "Universal" insulator supports, beam straps, conduit reaming device, conduit benders and locknuts.

THE FEDERAL RAILWAY SIGNAL COMPANY, whose machine shop at Troy, N. Y., on January 31, was completely destroyed by fire, has, during the past month, purchased the property of the Albany Forge Company, which property is located on the lines of the New York Central & Hudson River Railroad and the Delaware & Hudson River Railroad, at Albany, N. Y. The property consists of a completely equipped machine, pattern, carpenter shop and storeroom, which together with machinery recently purchased will enable it to commence at once the manufacture of signal material to as great an extent as it was manufacturing prior to the fire. The shops are located on a plot of nineteen acres of land on which the Federal Railway Signal Company proposes to put buildings sufficient for such business as it may be able to secure in the future. The company is arranging to erect an additional two-story building, 100 feet by 350 feet, for a machine shop, and a building 60 feet by 150 feet for a foundry, to take care of its increasing business, it having been demonstrated during the six months previous to the fire that the plant at Troy was inadequate. On the completion of these buildings, offices, foundry and blacksmith shop will be moved from Troy to the new location. The directors of the company are as follows: Robert C. Pruyn, president of the National Commercial Bank of Albany; James H. Caldwell, president of the Troy Trust Company, of Troy; J. T. Cade, Lawrence Griffith, P. G. Ten Eyck. The officers are: J. T. Cade, president; Lawrence Griffith, vice-president; P. G. Ten Eyck, general manager; Frederic Pruyn, treasurer; C. E. Newman, secretary.

Record of Electrical Patents.

Week of April 9.

849,368. ELECTRICALLY HEATED HOT WATER BOTTLE. Herbert W. Christian, Toledo, Ohio. An incandescent lamp is placed within the bottle.

849,375. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Relays enable any of the calling devices to be rendered inoperative.

849,432. ELECTRIC LOCOMOTIVE. Elmer A. Sperry, Cleveland, Ohio, assignor to Goodman Manufacturing Company, Chicago, Ill. A double reduction gearing is used.

849,443. CIRCUIT-CHANGING MECHANISM. Harry G. Webster, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. An electromagnet with straight armature mounted axially.

849,456. INDICATOR. George Brown, Sarnia, Ontario, Canada. An indicator operated by the engine-controlling mechanisms.

849,464. TELEPHONE TRUNKING SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A pair of main-line contacts is included in the talking circuit.

849,484. PRINTING TELEGRAPH. Charles J. Menasco, Birmingham, Ala., assignor of twenty-five one-hundredths to Rufus N. Rhodes and thirty one-hundredths to Richard C. Bankston, Birmingham, Ala. A synchronous printing system.

849,503. TROLLEY POLE. Quinto Saudelli, Fall River, Mass. A pantagraph pole.

849,511. BRUSH FOR DYNAMOELECTRIC MACHINERY. Charles W. Speirs, London, England, assignor to the Morgan Crucible Company, Limited, London, England. A metal strip is attached to one end of the brush.

849,574. ILLUMINATED SIGN. Hugo Ruger, New York, N. Y. The lamps are mounted so that they may be rotated.

849,582. REGULATION OF ELECTRIC MOTORS. Rowland Stebbins, New York, N. Y. A resistance is inserted in or cut out of the field circuit.

849,586. ELECTRIC SIGN. Benjamin Wall, Allendale, N. J., assignor to Metropolitan Engineering Company, New York. A method of construction.

849,593. ELECTRIC IGNITER. William H. Blood, Jr., Wellesley, Mass. An igniter for gas stoves.

849,606. INSULATOR. Albion Goldstein, St. Louis, Mo. A cap clamps the wire to the insulator.

849,612. WIRE COUPLING. Wilhelm Hofmann, Kötzschenbroda, Germany. The wires are held in a sleeve by a dowel pin.

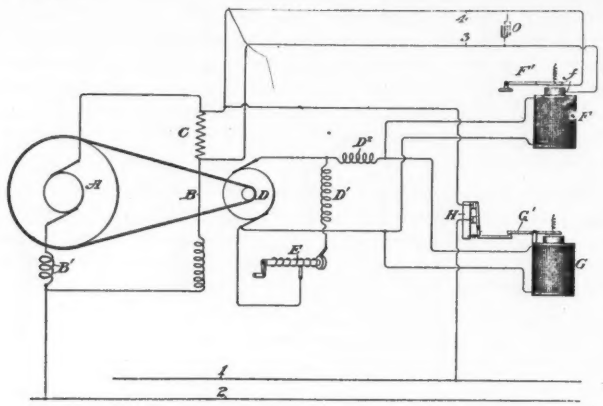
849,644. SELF-REGULATING SYSTEM OF ELECTRICAL DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Coupler Company, New York, N. Y. A separately excited generator, the voltage of which varies inversely with the speed.

849,653. ELECTROMAGNETIC APPARATUS. Emile Bachelet, Tacoma, Wash. A device for varying the number of turns in a solenoid.

849,666. TROLLEY FOR ELECTRIC RAILWAYS. Walter Edwards, Cedargrove, W. Va., assignor of one-third to George W. Keeney and one-third to William H. McQuillan. A wheel without an axle.

849,670. DYNAMOELECTRIC MACHINE. Samuel S. Forster, Schenectady, N. Y., assignor to General Electric Company. A method of constructing a vertical dynamo.

849,684. ELECTRIC SWITCH. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. A motor-starting switch.



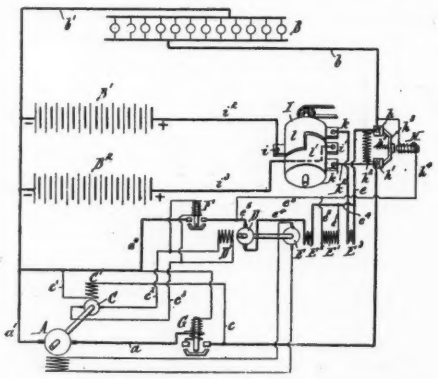
849,582.—Regulation of Electric Motors.

849,698. ELECTRICAL INDICATING APPARATUS. Albert A. Radtke, Chicago, Ill. The indicator is rotated, step by step, by a number of electromagnets.

849,703. ELECTRIC RAILWAY. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to General Electric Company. A third-rail system.

849,705. SYSTEM OF ELECTRICAL DISTRIBUTION AND REGULATION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Coupler Company, New York, N. Y. The voltage of the generator varies inversely, but in greater proportion, than the changes in speed, and directly with the changes in load.

849,706. COOLING DYNAMOELECTRIC MACHINES. Eddy R. Whitney, Swampscott, and Leonard A. Tirrill, Lynn, Mass., assignors to General Electric Company. A method of ventilation.



849,644.—Self-Regulating System of Electrical Distribution.

849,713. DYNAMOELECTRIC MACHINE. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Auxiliary field windings are provided.

849,731. INSULATOR. Siegmund Feuerstein, Rochester, N. Y. A cap holds the wire to the insulator.

849,745. ATTACHMENT TO TELEPHONE TRANSMITTERS. Flora G. Moulton, Chicago, Ill. A U-shaped coupling.

849,749. CONTROLLER FOR ELECTRICALLY PROPELLED VEHICLES. John S. Raworth, Streatham, England. A series-parallel controller.

849,762. AUTOMATIC PRESSURE-CONTROLLED ELECTRIC SWITCH AND AIR-GAUGE. Louis H. Westphal, Davenport, Iowa, assignor to Automatic Electric Pump Company, Davenport, Iowa. A pneumatically controlled switch.

849,773. THIRD-RAIL-PROTECTING MECHANISM FOR ELECTRIC RAILROADS. Hamlet Corrigan, Pittston, Pa., assignor of one-third to Charles Francis Curry and one-third to Michael H. Keating, Pittsburg, Pa. A slotted tube is placed over the third rail.

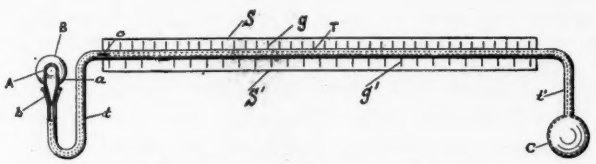
849,842. SAFETY-GATE-CONTROLLING MEANS. Charles S. Heller, Philadelphia, Pa. A gravity-actuated gate controlled by electromagnets.

849,850. TELEPHONE SYSTEM. Leopold F. Müller, Passaic, N. J. An intercommunicating telephone system.

849,871. TROLLEY. Richard W. Walker, Topeka, Kan. A pivoted trolley.

849,908. STEEL SUPPORTING STRUCTURE FOR ELECTRIC TRANSMISSION CABLES. Albert K. Mansfield, Batavia, Ill. A lattice-work pole.

849,919. TRANSMISSION OF SIGNALS. Alfred Perrin, Grenoble, France. A series of pendulums at the transmitting station, each of which controls synchronous corresponding pendulums at the receiving stations.



850,065.—High-Potential Measuring Instrument.

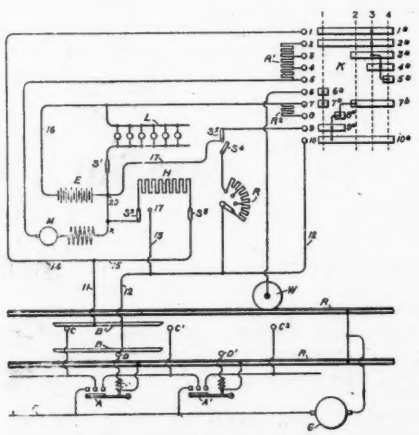
849,934. ELECTRICAL ROSETTE. George B. Thomas, Bridgeport, Ct., assignor to the Bryant Electric Company, Bridgeport, Ct. A rosette with central and lateral openings.

849,939. GROUND-WIRE ATTACHMENT. Clarendon L. Tichenor and Charles D. Stoneburner, Washington, D. C. A pole clamp for ground wires.

850,020. TROLLEY-WIRE HOLDER. Valcoure J. La Bauve, Houston, Tex. Wire guards project over the wheel.

850,064. APPARATUS FOR MEASURING ELECTRIC CAPACITY. Harry Shoemaker, Jersey City, N. J. The unknown capacity is compared with a known one.

850,065. HIGH-POTENTIAL MEASURING INSTRUMENT. Harry Shoemaker, Jersey City, N. J. An indicating bead is moved in a tube by vapor pressure.



850,117.—Electric Railway.

850,079. TELEPHONE-REPEATER SYSTEM. Nathaniel G. Warth, Columbus, Ohio. Twin telephone repeaters provided with twin local circuits.

850,081. AUTOMATIC PRESSURE-CONTROLLED ELECTRIC SWITCH AND AIR-GAUGE. Louis H. Westphal, Davenport, Iowa, assignor to Automatic Electric Pump Company, Davenport, Iowa. The swinging arm is controlled by fluid pressure.

850,101. DROP FOR ELECTRIC CIRCUITS. William H. Robins, Minneapolis, Minn., assignor to American Bank Protection Company, Minneapolis, Minn. The circuit closer is released by an electromagnet.

850,117. ELECTRIC RAILWAY. William B. Potter, Schenectady, N. Y., assignor to General Electric Company. The car operates electromagnetic switches, which connect sections of the working conductor to the feeder.